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VETERINARY SCIENCE ASSOCIATION
OF AMERICA

NOTES ON
VETERINARY ANATOMY

BY

CHARLES J. KORINEK, V. S.

Graduate of the Ontario Veterinary College, in affiliation with the University of Toronto, Canada. Hon. Member of the Ontario Veterinary Medical Society. Ex. State Veterinarian for Oregon. Ex. President of the Oregon State Veterinary Medical Board of Examiners. Author of "The Veterinarian". Principal of the Veterinary Science Association of America. Sixteen years of Practical Experience as a Veterinary Surgeon.

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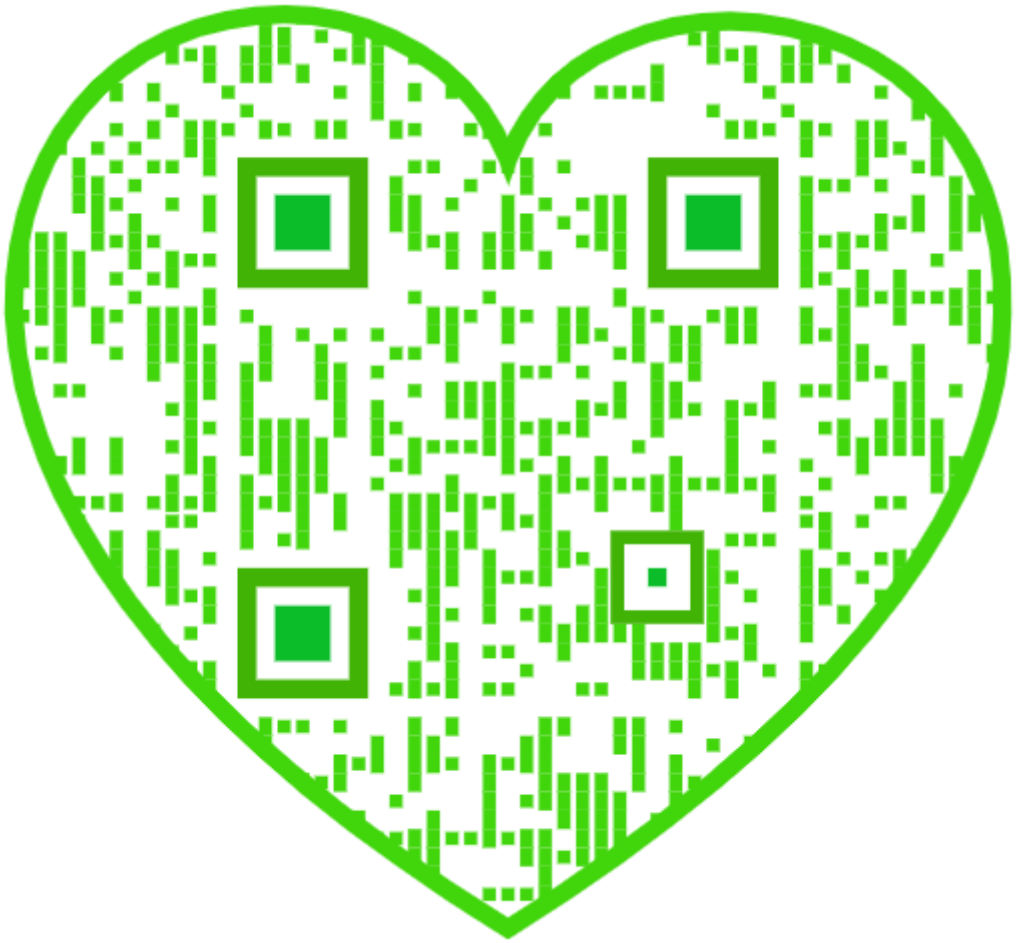

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PREFACE

There are a number of excellent works on Veterinary Anatomy, and many of them will amply repay the student for the time taken to master them, but for quick reference none seem to contain the wants of the veterinary practitioner and student for which this humble little work is primarily intended.

It has been my endeavor to briefly describe each organ as found in the healthy animal; its functions, etc., in a condensed yet complete form. I am positive that the student or veterinary practitioner will find its pages highly instructive as well as profitable and interesting.

In compiling this work a few authorities have been consulted and quoted, while it has not been practical to give individual credit for the use of ideas and language, a general acknowledgement is here made:

Veterinary Science, Hodgins and Haskett.

Veterinary Anatomy, Strangeways.

CHARLES J. KORINEK, V. S.

DESCRIPTIVE ANATOMY

Osteology is a term applied to that section of descriptive anatomy which treats of the bones. *Arthrology,* to the consideration of the joints or modes of union between the bones, while by *Myology* is meant the doctrine of the muscular system. *Splanchnology* treats of the viscera, *Angiology* of the circulatory and absorbent systems. *Neurology* deals with the nervous system. *Aesthesiology* with the organs of sense; while *Embryology,* as before stated is the consideration of the animal frame at periods preceding its birth.

In this work the various departments are discussed in the order here given. The structures which are the subject of the first three divisions are sometimes classed together as the *Organs of Locomotion;* for bones form the frame work of the body and often act as levers; the joints connect the bones, permitting more or less motion between them; while the muscles move the bones, and so produce motion of a part of the body—or it may be locomotion, or change of situation in the entire frame.

In the study of comparative Anatomy the terms *analogy* and *homology* are frequently met with. Although these words are unfrequently used indiscriminately, the following differences should be noted. Organs are said to be analogous when, through differing in structure, they preform the same function; but when their functions are different, which, in the broad sense, they correspond in structure or form, they are said to be homologous. Thus the middle finger of the human hand is the homologue of the anterior (front) digit of a horse, because they have the same general structure, and relation to the rest of the limb; but as the functions they perform are quite dissimilar, they cannot be termed analogous. Again, the lungs of a mammal are analogous to the gills of a fish, for, though they differ widely in structure, position and form, and

are therefore not homologous, their ultimate use is the same—each of them being an apparatus in which is carried on the process of purifying the blood.

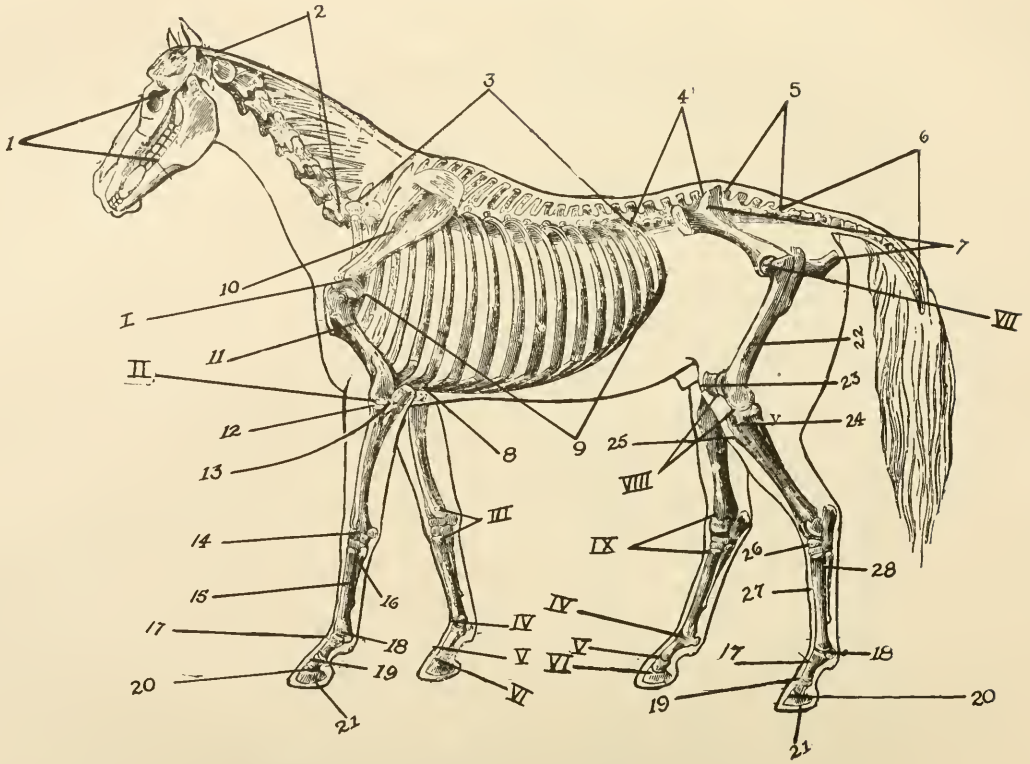
DISSECTION.

Students must dissect as many animals as possible, so as to familiarize themselves with the *frame work or structure,* and the location of the *digestive, nervous and blood systems,* as it will aid materially in the art or process of determining the nature of various diseases.

During cool weather an animal for dissecting purposes can be kept for a considerable length of time without preservatives

It is well to have a copy of Anatomy at hand when dissecting for it will show the location of the various organs and explain their functions.

PLATE I.



SKELETON OF HORSE—AFTER MEGNIN.

EXPLANATION OF PLATE I

Skeleton of the Horse

1. Skull, or skeleton of the head.
2. Cervical vertebræ or neck bones.
3. Dorsal vertebræ or back bones.
4. Lumbar vertebræ or loin bones.
5. Sacral vertebræ or rump bones.
6. Coccygeal vertebræ or tail bones.
7. Pelvic or hip bones.
8. Sternum or breast bone.
9. Ribs.
10. Scapula or shoulder blade.
11. Humerus or shoulder bone.
12. Radius or bone of the fore-arm.
13. Ulna or bone of the fore-arm.
14. Carpus or bones of the knee.
15. Os Melacarpi Magnus, metacarpal, or cannon bone.
16. Ossa Melacarpi Parva, or splint bones.
17. Proximal Phalanx, os suffraginis, or large pastern bone.
18. Great Sesamoid Bones.
19. Medium Phalanx, os coronæ, or small pastern bone.
20. Distal Phalanx, os pedis, or coffin bone.
21. Os Naviculare, small sesamoid, or shuttle bone. (This bone can be plainly seen Plate VII).
22. Femer, or thigh bone.
23. Patella, or stifle bone.
24. Tibia, or leg bone.
25. Fibula. (This bone is little developed in the horse.)
26. Tarsus or hock bones.
27. Metatarsus, or os metatarsi magnus.
28. Ossa Metatarsi Parva, or splint bones of the hind leg.

Names of joints placed according to numbers.

I. Shoulder Joint.
II. Elbow Joint.
III. Carpus or knee joint.
IV. Fetlock Joint.
V. Pastern Joint.
VI. Coffin Joint.
VII. Hip Joint.
VIII. Stifle Joint.
IX. Tarsus or hock joint.

CHAPTER I.

OSTEOLOGY.

Structure of the Bones—Bones are hard, yellow-white, insensitive objects, which form the skeleton and give attachment to soft structures (muscles, tendons and ligaments); they are of various sizes, forms and densities. In the limbs the bones are ordinarily more or less long, circular bodies, with expanded ends, effectually supporting the body, supplying leverage and attachment for soft structures, and forming the basis of all joints. Where cavities, such as the cranium, chest, and pelvic, enclosing the organs requiring protection and support, the bones tend to assume a flat, expanded form.

Living bone is bluish pink, insensitive, and elastic; on exposure to air it becomes diseased and blackened, very sensitive and painful; (the teeth excepted) which are harder and of a higher specific gravity than any other bone formation.

Bones are composed of two kinds of substance—animal, which makes the bone tough and flexible; earthy, which makes it hard and fragile. In young animals the animal matter forms about one-half of the bone substance; in the adult, it diminishes to about a third, while in old animals it is still less; hence the bones of very old animals are brittle, more liable to fracture and harder to mend.

Bones in a six-year-old horse contained, Phosphate of Lime, 54.37 per cent; Carbonate of Lime, 12.00 per cent; Phosphate of Magnesia, 1.83 per cent; Soluble Salts, 0.70 per cent, or mineral matter, 68.90 per cent. While they contain Cartilage, 27.99 per cent; Fat, etc., 3.11 per cent, or animal matter 31.10 per cent.

In bone tissue there are two modifications of texture, the *compact* and the *cancellated*. The former—hard,

dense, and ivory-like, is always situated externally; the latter porous and spongy lies within.

Although the compact tissue appears uniformly dense, and destitute of porosity, yet, if we transversely sectate the shaft of a long bone, and examine it under the microscope, by transmitted light, it is found to contain numerous round openings. These are called *Haversian canals.* They transmit bloodvessels, and run in a longitudinal or slightly oblique direction, opening on either the outer or inner surface of the bone.

The external (outer) surface of every bone is covered by a tough, fibrous, inelastic membrane called periosteum, which can be seen by examining the bone of an animal which has recently died. The only exception to this is at the joints where one bone articulates with another, and where a tendon or muscle plays over a bone; here we find its place taken by articular cartilage. By its strength it sometimes retains bones in contact after an oblique fracture; in the young, it is thicker and more vascular than in the adult. Blood-vessels which penetrate the periosteum pass directly to the bone; the outer surface of the bone is always studded with numerous *foramina* through which these enter.

The periosteum owing to its inelasticity, is, when inflamed, the seat of intense pain; and should any part of it be stripped off, there is every probability of the denuded bone dying and separating.

Contents of Bone.—Red marrow is found in the extremities or near the ends of bones, white marrow is found in the shaft.

Classes of Bones.—Bones are classed as long, flat, and irregular. Long or cylindrical bones are found in the limbs or extremities, and serve as levers and pillars for traveling and to support the body. Descriptively, a long bone is divisible into a center or *shaft* and two ends or extremities. Flat bones are found where visceral organs need protection. As the shoulder or scapula and ribs, to protect the heart and lungs; pelvic or hip bones,

to protect the rectum and urinary and genital organs; also the cranial bones, to protect the vital organ called the brain. Irregular bones are found in the spinal column and in the joints, such as the knee or carpus, hock or tarsus, where great strength is required. They usually possess many angles and indentations, with surfaces for articulation and tendonous attachment, and consist of a thin, dense, external (outer) case of compact bone enclosing cancellated tissue. In proportion to their size they present a much larger extent of articular surface and greater mechanical strength than any other class.

1. Skull, or skeleton of the head, the most anterior (forward) part of the horse's skeleton, articulates with the first cervical vertebra (or atlas), from which it is suspended by its posterior (or back part) extremity, its anterior (forward) extremity being free. Its position varies with the attitude of the animal; but in our descriptions we shall always suppose it to be placed in a horizontal position.

In the young animal the skull is composed of a number of bones, all of which, with the exception of the lower jaw, the teeth, the bones of the tongue, and ossicles of the ear, become united by ossification (growing together) in the adult.

In speaking of the different points of importance in connection with the head bones of the horse, and other animals, suppose a cross or longitudinal section of the head is made. It will be noticed that it is full of cavities or sinuses. The uses of these are to lighten the head and also to warm the air as it passes into the nostrils, on its way down to the lungs. It will also be found full of foramen or small holes through which the nerves from the brain and various blood vessels pass to the organs situated in the head, such as the tongue, lips and the various glands in and around the head.

Then there are the cavities in which the eyes are situated, one on each side of the head, called the orbital fossa. In examining this fossa you will find a small

opening or foramen, through which the optic nerve passes in coming from the brain to the eye. This is the nerve of sight. Then the most important part of all to consider is the cranial cavity in which that very important organ is situated called the brain, which controls all the various functions and movements of the body.

Another important point is the situation of the ear drum. It is situated in the hardest bone found in the whole skeleton, called the petrosal. The nerve that gives the function called hearing comes from the brain down to the petrosal bone and enters by a small foramen or hole into the drum of the ear to give hearing. This nerve is called the auditory nerve.

2. Cervical Vertebrae or Neck Bones.—These bones are seven in number. The first and second bones proceeding from the head receive special names. The first one is called the atlas, from which the head is suspended and to which it is attached; it somewhat resembles the body of a bird with wings extended. The second bone receives the name of dentata. This is the bone which allows the head to turn in any direction, hence it is sometimes called the axis or pivot of the neck. Between these two bones, on the upper surface, is the only place where the spinal cord is not covered with bone, a spot about three-fourths of an inch in diameter. The next four bones receive no name, and are about the same in size and length. The last, or the seventh bone, is only about one half the length of the preceding ones and receives no special name.

3. Dorsal Vertebrae or Back-Bone. — Dorsal bones are eighteen in number. The chief point of interest about them are the height of the spines on the upper surface of the bones. These large spines form the withers of the horse, as will be noticed in the skeleton. On either side of these bones the ribs are attached, 18 pairs corresponding with the number of bones in this region.

4. Lumbar Vertebrae (or the bones which form

the skeleton of the loins). These bones are six in number, and they are situated immediately above the kidneys.

5. Sacral Vertebrae or Rump Bones.—There are five of these bones in the young horse, but in the adult they unite as a single bone, somewhat triangular-shape. These are situated between the upper hip bones and help to form the rump. Beneath these bones the bladder is situated.

6. Coccygeal Vertebrae or Tail Bones.—These are 18 to 20 in number. There is no complete canal, like in the previous vertebraes, for enclosure of the spinal cord.

7. Pelvic or Hip Bones.—The pelvic bones are flat, but somewhat irregularly-shaped, and they form the sides, floor, and part of the roof of the pelvic cavity. Above they are connected with the sacrum, and below united to each other, in the adult, by ossification (union of bone). In the young animal, as above stated, and especially in the foetus, each side consists of three parts, which retain their names of ilium, ischium, and pubis, even after union by ossification. They all three meet in the acetabulum, or articular cavity for the femur or hip bone.

8. Sternum or Breast Bone.—This bone is small and short in the horse and is situated on the lower surface of the chest cavity. The principle points to be noted in this bone are that of its softness, and that the first eight pairs of ribs are attached to it on either side. This bone, in the horse resembles the keel and cut-water of a boat.

9. Ribs.—In the horse the ribs usually number eighteen on each side. They extend in a series of arches of varying curvature from the dorsal vertebrae above, towards the sternum and sides of the abdomen below. Their shape, in a great measure, determines the conformation or shape of the thorax or chest cavity; they protect its contents, and materially aid in its contraction and expansion. They are continued downward and for-

ward by a small piece of cartilage or gristle, and are just slightly attached to the breast bone or sternum; these are called the false ribs. Note that, starting with the first rib, they get longer until the ninth rib is reached; they then get shorter, the last rib being only a few inches long.

10. Scapula or Shoulder Blade.—The scapula is a flat bone situated on the antero-lateral (front side) surface of the thorax or chest cavity, it is triangular in shape, the base being turned upwards. The inferior or lower extremity articulates with the humerus or shoulder bone.

11. Humerus or Shoulder Bone.—The humerus is a long bone extending from the scapula to the radius and ulna in an oblique direction downwards and backwards. Like all long bones it possesses a shaft and two extremities and two articular surfaces.

12. Radius, or Bone of the Fore-arm.—The radius is a long bone, and occupies a vertical position between the humerus and the carpus.

13. Ulna, or Bone of the Fore-arm.—The ulna is an irregular bone, in form triangular, with the base uppermost, and is placed on the supero-posterior or (upper and back) part of the radius.

14. Carpus, or Knee.—The carpus, knee or wrist, as it is incorrectly termed in quadrupeds, is composed of seven and often of eight small, irregular bones arranged in two rows of three each, one above the other, the seventh being at the back of the three in the upper row, and the eight, when present, in a similar position with respect to the lower row. Their names are as follows: scaphoid, lunar bone, cuneiform bone, trapezium, trapezoid, os magnus, unciform, pisiform, which is not always present.

15. Os Metacarpi Magnus, Metacarpal or Cannon Bone.—The large metacarpal, or cannon bone, is a long, straight bone, placed in a vertical direction. Its

superior or upper extremity articulates with the carpus and its inferior or lower extremity articulates with the os suffraginis and the two sesamoids.

16. Ossa Metacarpi Parva, or Splint Bones.—The two small metacarpal, or splint bones, tuberous in form (marked or covered with projections) at the carpus and tapering distally (lower portion), are attached to the large bone, one on each side of its posterior (back) surface, by ligaments in the young animal, and by ossification (union of bone) in most grown up, and in all old animals.

17. Proximal Phalanx, Os Suffraginis, or Large Pastern Bone.—The os suffraginis, or large pastern bone, passes obliquely downwards and forwards, and articulates with the cannon bone above, and the median phalanx or os coronae below. It belongs to the class of long bones.

18. Great Sesamoid Bones.—These bones, two in number, are placed side by side at the postero-inferior (back and lower) part of the metacarpus and postero-superior (back and upper) part of the os suffraginis; they are irregular in shape, their back parts are covered with cartilage, for the passage of the flexor tendons of the digit or the last four bones of the limb. Their superior or upper surface is roughened, and their sides, which are grooved for the reception of the suspensory ligament. (This is called the fetlock joint.)

19. Median Phalanx, Os Coronae, or Small Pastern Bone.—The second phalanx, os coronae, or small pastern bone, has no marrow canal, and belongs to the class of irregular bones. It is inclined, like the os suffraginis, obliquely downwards and forwards, and is partly covered by the hoof. The upper portion of this bone articulates with the os suffraginis and the two sesamoids, the lower part articulates with the os pedis.

20. Distal Phalanx, Os Pedis, or Coffin Bone.

—The third, or ungual phalanx, os pedis, or coffin bone, is an irregular bone situated within the hoof, and, when in a healthy state, corresponding somewhat to it in shape, being semilunar in form, with the convexity to the front, This bone is very hard and porous, having many openings for the transmission of arteries and veins. In this bone we notice the wall, the sole, the tendonous surface, the articular surface, and the alae or wings. This bone articulates with os coronae superiorly (upper) and posteriorly it articulates with the os navicular bone.

21. Os Naviculare.—The naviculare, third or small sesamoid, or shuttle bone, is an irregular bone, situated with its long axis transversely, behind and below the os coronae, and behind the os pedis, with both of which it articulates, the articulation of the three forming the so-called *coffin* joint. The lower surface of this bone is important as it is covered with cartilage, and together form a kind of a pully over which plays the great flexor perforans muscle. The remaining portion of the anterior limb or front leg, will be considered under anatomy of the foot. The navicular bone can be plainly seen on Plate VII, anatomy of the foot.

22. Femur or Thigh Bone.—The os femoris, femur or thigh bone, the largest, thickest, and strongest bone in the body, belongs to the class of long bones, and is placed in a direction obliquely downwards and forwards, articulating with the cup-shaped cavity in the pelvic or hip bones superiorly (or upper), and with the tibia and patella inferiorly (or below). This bone is roughened for the attachment of the powerful muscles of the hip.

23. Patella, or Stifle Bone.—This, the knee-pan or stifle bone, is placed in front of the pully-shaped groove of the femur. It is very compact, its front surface being irregular, round and very much roughened, for ligamentous attachment, and its posterior (or back) surface very smooth to articulate with the groove in the femur, presenting two depressions divided by a ridge,

the inner being the larger, and in the fresh state enlarged still more by projecting cartilaginous lip, or elevation. The patella increases the power of the hind leg, and it is this bone that causes stifle joint lameness when it slips out of the groove in which it glides normally.

24. Tibia, or Legbone.—The tibia or leg bone, is a long bone, larger at its upper than its lower end, situated between the femer and the astragalus, slanting downwards and backwards. This bone is three-sided, possessing outer, inner and back surfaces, all of which are wider above than below. This bone gives attachment to the flexor muscles of the hip.

25. Fibula.—This is a long slender bone, little developed in the horse, and is an appendage to the tibia, being attached to the outer side of that bone, and extending from its head to its lower third, to which it is affixed by a ligament; the space between the two bones is called the tibial arch. The fibula gives attachment to the peroneus muscle, the muscle that is supposed to be severely contracted when an animal is affected with string-halt.

26. Tarsus, or Hock Bones.—The tarsus, or hock, corresponding to the ankle-joint of a man, is composed of six irregular compact bones, situated between the lower end of the tibia and the superior or upper extremity of the metatarsus; they are arranged in two series; one consisting of the cuboid and three cuneiform bones, the magnum, medium, and parvum, corresponds to the lower row or carpal bones; the other upper series consists of the astragalus and calcaneum; the first, forming with the bone above the mobile portion of the joint, may be said to correspond to the upper row of carpal bones, while the latter, being the lever bone, corresponds to the trapezium. These bones, like those of the carpus, are thickly covered with cartilage on their articular surfaces, which acts as a protection against concussion. It is these bones that become diseased and united when an animal is affected with bone spavin. The calcaneum bone which forms the prominent part, termed the point of the hock,

and corresponds to the heel-bone of man. This bone gives attachment to the calcaneo-cuboid ligament, and it is this ligament that is sprained or ruptured in curb of the hock.

28. Metatarsus, or Os Metatarsi Magnum.—This bone presents the same general appearance as the large metacarpal or cannon bone, from which it differs principally in being about one-sixth longer and flattened from side to side. It is rounded and more prominent in front. This bone articulates above with the tarsus bones, and its lower portion articulates with the os suffraginis.

28. Ossa Metatarsi Parva, or Splint Bones of the Hind Leg.—These also present the same general form as the small metacarpal bones of the front leg; the outer is the longest and largest, and has the largest head, with two surfaces which articulates with the cuboid bone; the inner one has also three articular surfaces, two for small, and one for the middle cuniform bones. The two surfaces on each head articulate with corresponding ones on the large metatarsal bone. The remaining bones of the hind extremity, viz.: the three phalanges, with their three accessory bones, so closely resemble the corresponding bones of the fore extremity, that it seems at first sight difficult to distinguish one from the other; the chief differences being, that the first phalanx of the hind extremity is longer; its upper end larger, and its lower end smaller, than in the fore extremity.

COMPARATIVE OSTEOLOGY.

In this section we shall endeavor to point out where the skeleton of the domesticated animals, other than the horse, differ from the typical skeleton of the latter in any important particular. The following descriptions are therefore in all cases comparisons, where comparison is possible, between the typical skeleton and the skeleton in question.

RUMINANTIA.

(Cud Chewing Animal.)

In this class we take the ox as the animal which represents the best for our purpose, the family of ruminating or cud-chewing animals, as cattle, sheep and goats.

The Skull or Cranium.—In the skull of the ox an important feature is the development of the frontal or forehead bone, which extends from below the eyes to the back of the skull, forming the entire forehead and crest or top, in the middle of which is the forehead tuberosity or knob-like elevation, which is very large in hornless animals. Springing from the sides of the top are two processes, varying in size and shape, but corresponding to the shape of the horns, which they support.

Vertebrae.—The true vertebral column is made up of 26 bones divided into seven cervical or neck-bones, 13 dorsal or back-bones, and six lumbar or loin bones.

Cervical or Neck-Bones.—The bodies of these bones are shorter than those of the horse, but same in number.

Dorsal or Back-Bones.—These bones are longer than in the horse, but have the same general form. It

gives attachment to 13 ribs on each side in the same manner as those of the horse.

Lumbar or Loin Bones.—The lumbar vertebrae are longer and thicker than in the horse, their bodies being more round on the sides and lower surfaces.

Sacrum, or Rump Bones.—The sacrum is larger and more arched, and the upper surface more round than in the horse.

Coccygeal or Tail Bones.—The tail bones are from 15 to 20 in number, are strong and rougher than those of the horse.

Pelvis or Hip Bones.—The pelvis is larger, but presents the same general appearance as in the horse.

In studying the bones of the limbs in ruminants, the only point of difference is in bones below the knee. The large metacarpal bone presents a vertical groove down its front, which marks the original division of the bone into two bones. The lower extremity is divided by a deep groove into two articulations, each resembling the single one of the horse. The outer one being always the smaller, a rudimentary metacarpus is placed on the back and outer surface. The pasterns and sesamoids in either limb are double, one set forming each digit; they are small and narrow, the coffin bone resembles half of that of the horse, equally divided.

In the aged ruminant, two bones are commonly found in the heart, and may be termed the cardiac bones. They are found related with auriculo-ventricular rings. In shape they present three angles, three borders, and two surfaces. The left bone is somewhat smaller then than the right.

OMNIVORA.

Animals eating both vegetable and animal food.

The omnivora are represented in veterinary anatomy by the hog.

CARNIVORA.

An order, suborder, or family of mammals, especially wild animals, including the dog and cat, etc. Animals that eat flesh.

In this order our description alludes mostly to the dog.

AVES.

The scope of the present work will allow only very brief treatment of this part of the subject.

Of or pertaining to Birds, Poultry, Etc.

The bone tissue or substance of birds are exceedingly compact and hard, white in color; and some of the bones are pneumatic, or contain air instead of marrow, notably these are bones of the skull, the sternum or breast bone, and the upper bones of the limbs. There are a great variety in the amount of pneumaticity or air possessed by the skeleton of different species, but it is not necessarily determined by the flying power of the animal.

CHAPTER II.

ARTHROLOGY.

What is known regarding the articulations of bones of joints. The several bones which form the skeleton are united by means of certain soft structures, forming a number of articulations or joints, the study of which is termed arthrology.

Before considering the different forms of joints, it will be advisable to describe briefly the various tissue, other than bone, which enter into and contributes towards their formation. These are chiefly cartilage, connective and elastic substance or tissues, and fat.

In health, one bone never comes directly in contact with another, cartilage or fibrous tissue being always interposed; an exception to this exists in the adult skull, most of the bones of which become firmly united by ossification of the interposed soft material.

Cartilage.—Cartilage, known also by the familiar name of gristle, is a firm, bluish-white elastic animal substance, somewhat transparent, resilient, and flexible, possessing great cohesive power. That which forms the original basis of the bony framework is termed temporary, and that which persists in the adult, permanent cartilage; the former disappears as it is replaced by bone, but the latter, of which alone we have to treat here, never under normal circumstances become ossified. Cartilage consists of corpuscles or cells, usually embedded in an intercellular substance.

The articular cartilage is important as it encrusts the articular surfaces of bones, helping to form joints by supplying smooth, elastic cushions, which diminishes both concussion and friction.

Connective Tissue (White fibrous tissue.)—In one

form or another this tissue is found in all parts of the body. The chief varieties are the areolar and the fibrous; the former serving as a connecting medium, and support to the various organs, and to the structures of which they are formed. It appears as a loose, transparent mesh, its interwoven bundles forming spaces termed the areolar or cells.

Connective tissue contains nerves and blood-vessels, for the supply of neighboring structures as well as for its own nourishment. When healthy it is little sensitive to pain.

Yellow Elastic Tissue.—This differs from the white or connective tissue in being yellow, elastic, and not so tough or strong. Its fibers are usually large but when mixed with the white tissue in tendons the size diminishes.

Yellow elastic tissue is found nearly pure in the ligamentum nuchae, and tunica abdominis, the coats of the largest arteries and elsewhere. The lungs contain a large quantity of this tissue.

When white fibrous tissue is boiled gelatine is obtained, which is not the result of boiling the yellow elastic tissue.

Adipose Tissue.—Fat or adipose tissue consists of cells containing an oily material, and arranged in isolated groups, or slightly separated by meshes of areolar tissue. It is found in many parts of the body, and varies greatly in quantity; in joints it occurs between the ligaments, and serves the purpose of a packing material, while in the form of medulla or marrow it occupies the cavities of bones. In fat cell a nucleus is very rarely visible.

Ligaments.—Ligaments are dense, fibrous, connecting structures. They exist in most articulations, and are made up principally of white fibrous tissue. There are two kinds—capsular or bursal, and funicular or binding ligaments.

Capsular ligaments are membranous structures en-

closing true joints. They consist of a dense interlacement of fibers attached to bones, round the edges of the articular cartilages; some regard them as a continuation of the periosteum or the covering of bone. They are never closely applied, their use being to form cavities round the joints, enclosing and protecting the synovial or lubricating apparatus inside.

Funicular or binding ligaments consist of rounded or flattened cords, or bands of fibrous tissue, passing from one bone to another, firmly attached to roughened portions of their surfaces. They hold the bones in their places, at the same time allowing the requisite amount of motion in the joints. Ligaments which are situated between bones are often termed interosseous. Annular ligaments are those which bind down and protect the tendons of muscles in certain joints, converting grooves in the bones into channels or tubes which are lined with synovial membrane, and through which the tendons play.

Some ligaments are composed almost entirely of yellow elastic tissue, such as the ligamentum nuchae (the elastic ligament of the neck) and the ligaments connecting the vertebral arches (arches between the bones of the spinal column).

Synovial Membranes.—These are thin membranes lining the capsular ligaments of joints, or they are interposed elsewhere between structures which move one upon another, and which would otherwise be injured by the friction. Near the borders of articular cartilages the membrane is generally found as a projecting fold, the projection being due to a small pad of fat, interposed between the membrane and the capsular ligament. These projections were once erroneously termed synovial glands, but their use is probably to assist in forcing the synovia between the opposing surfaces of cartilage.

Synovia.—Synovia or joint oil, is a viscid, transparent fluid, colorless, or pale yellow, physically resembling oil, but it contains very little fatty material, consisting chiefly of albumen, salts and water; it is secreted by the

cells of the inner surface of the synovial membrane. When an animal is in active exertion, there is a greater demand for joint oil than when at rest, consequently there is an increased secretion of it.

Classes of Joints.—Joints may be divided into three classes—Immovable, movable and mixed.

Motion in Joints.—The following terms express the various movements allowed by joints—*Extension* tends to bring two bones as nearly into a straight line as the structure of the joint will permit; *flexion* is the reverse of this, and diminishes the angle that extension increases; *abduction* expresses the outward movement of a limb or bone from the central line of the body; *adduction* is the reverse action; rotation signifies the partial *revolution* of a bone or number of bones, as it were, on their own axis; *circumduction* implies the movement of the lower end of a bone or limb, where it describes a curve, as the bow of a circle, *ellipse*, etc. The term gliding explains itself, and is peculiar to movable and other joints having no frictional surfaces.

Important points of joints to be considered will be described on Plate I by Roman figures to correspond with those given below.

Joints of the Front Leg.

I. Shoulder Joint.—This joint is formed by the lower end of the scapula, or shoulder blade, and the upper end of humerus or shoulder bone. This is a ball-and-socket joint, and is held in its place by ligaments and muscles. This belongs to the class of rotation joints, its action is outward, inward, backward and forward.

II. Elbow Joint.—This joint is formed by the lower part of the humerus and the upper portion of the radius and ulna. It is covered with ligaments and muscles similar to the above mentioned joint. This is a hinge joint the action of which is only forward and

backward, or flexion and extension. It has no lateral movement.

III. Carpus or Knee Joint.—This joint has been explained very thoroughly in the previous chapter. There are three separate articular surfaces in this joint. This joint has a large capsular ligament, and has binding ligaments one above the other, the seventh being at the back of the three in the upper row, and the eight, when present, in a similar position with respect to the lower row. Thus there are three separate articular surfaces in this joint. The upper surface of the carpus articulates with the radius; this forms the hinge joint of the knee and is where flexion and extension takes place. Another articulation between the upper and lower carpus bones give slight motion to the knee, but not so much as the upper articular surface. Between the lower surface of the lower row of carpus bones and the upper extremity of the metacarpal, or cannon bones, is another articular surface which gives motion to the knee. This joint has a large capsular ligament, and has binding ligaments inside and outside. In addition to the flexion and extension movement the knee joint possesses, it also serves as a cushion and relieves concussion of the fore limb.

IV. Fetlock Joint.—This joint is formed above by the lower portion of the metacarpal, or cannon bone, and below by the part of the os suffraginis or the large pastern bone. At the back of this joint there are two small bones called the sesamoid bones. This joint has a capsular and two lateral binding ligaments. The motion of this joint is a backward and forward or flexion and extension, same as that of the knee.

V. Pastern Joint.—This joint is situated just above the hoof, and is formed by the lower end of the os suffraginis or large pastern bone and the upper end of the os coronae or small pastern bone. It has a capsular and lateral binding ligaments, same as the fetlock joint. It also has the same motion as the fetlock joint, and is often the seat of what is termed a high ringbone.

VI. Coffin Joint.—This joint is situated within the hoof. It is formed above by the lower end of the os coronae or small pastern bone, and below by the upper surface of the os pedis or coffin bone. Immediately behind this joint, and articulating with the two mentioned bones, is the navicular, or shuttle bone—it gets its name from its likeness to the shuttle of a sewing machine. This bone when diseased is the seat of navicular disease, or coffin-joint lameness. The action of this joint is very slight forward and backward.

Joints of the Hind Leg.

VII. Hip Joint. The hip joint is formed by the pelvis and femur bone. This is a true ball-and-socket joint similar to the shoulder joint. It has a capsular, and is called the round ligament, in the joint, holding the head or ball on the femur in the socket of the pelvis. This can be seen plainly by examining the joint. This round ligament is important, as it often becomes strained, being the seat of hip joint lameness. It is also held together by the strong muscles of the hip. Its motion is rotation similar to that of the shoulder joint.

VIII. Stifle Joint.—This joint is formed above by the lower end of the femer, or hip bone, and the upper end of the tibia or thigh bone. These two bones in front form a pulley-like surface on which the patella, or stifle bone, is situated. This bone, when the joint is in motion, glides up and down over the pulley-like surface. It sometimes becomes displaced, and this is termed dislocation of the patella or stifle bone. This is an important point to notice about this joint. It has a capsular and lateral, or binding ligament, which hold the stifle bone to its place as it plays upon the pulley-like process of this joint. The action of this joint is only forward and backward or flexion and extension. It has no lateral or side motion.

IX. Tarsus or Hock Joint.—This joint contains six bones. The two upper bones, one of which is a pulley-

like bone placed in front, and the other placed behind, forms that portion of the hock which is called the point of the hock to which the muscles of the gambe are attached. It can be easily seen or felt. The upper surface of these two bones articulate with the lower portion of the tibia or thigh bone, and forms a true articulation of the hock joint. This part is what gives most of the motion to the joint. Below these are three other small, irregular bones, placed one upon the other, having an articular surface between them. Immediately behind these three small bones is what is called the cuboid bone. This bone also articulates with the three small irregular bones, helping to form the articular surface of the hock. The lower articular surface helps to give a small amount of motion to the joint. This joint is the seat of bone or bog spavin due to severe sprains, or poorly conformed joints.

Fetlock, pastern and coffin joints of the hind leg are so closely allied to those of the fore leg that it is not worth while discriminating between them.

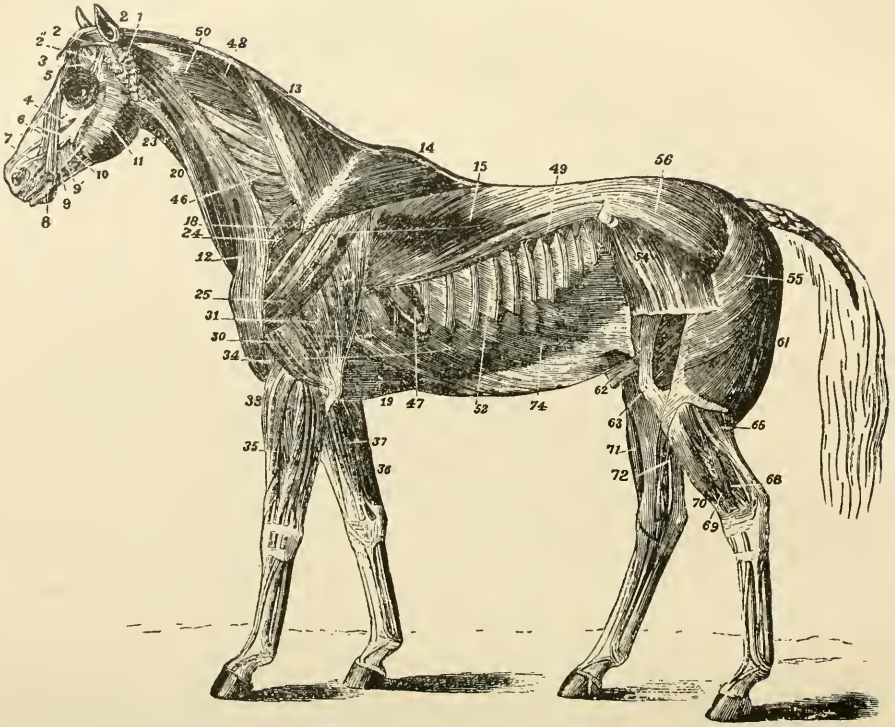
CHAPTER III.

MYOLOGY.

The branch of anatomy which treats of the muscular system is called Myology.

Muscles are the active organs of motion, or locomotion, each being separated from the other by a thin delicate membrane made up of connective tissue, which forms a sheath for the muscle. A muscle is divided into two parts, viz.: muscular and tendinous. The muscular part is the larger of the two. It is sometimes called the belly of the muscle or flesh. This part is known as muscular tissue, and has a reddish, meaty color. At both ends of the muscle there is a tendinous part, or the hard, white portion of the muscle which becomes attached to the bone. All muscles are attached to two or more places of different bones, and when contracted, the joints of the body are moved. They are well supplied with nerves, which give strength and feeling, and also well supplied with small blood vessels, from which the muscle is fed. Muscles are found in separate groups, all of which have different actions to perform. There are two kinds of muscles—voluntary and involuntary. The voluntary muscles are under the control of the will of the animal; example—the muscles of the head, neck, back, hip and legs. The involuntary muscles are beyond control of the animal, and will act even though the animal were asleep—such as those of the heart, the large muscular curtain which separates the chest cavity from the abdominal cavity, which is one of the great muscles of breathing; also the muscles around the chest which assist in breathing.

PLATE II.



MUSCLES OF THE HORSE—SUPERFICIAL LAYER—AFTER MEGNIN.

EXPLANATION OF PLATE II.

Muscles of the Horse.

This illustration shows the superficial muscles of the body after the skin and pannisulus carnosis muscle has been carefully removed. This muscle is spread over the greater part of the body, which is related externally with the skin; internally with the superficial layer of muscles. Its action corrugates the skin, and thus enables the animal to expel or shake off insects and irritating bodies, its use being thus protective to some extent; it also supports and binds down the superficial muscles.

SUPERFICIAL LAYER.

The panniculus and tunica abdominalis are removed.

1. Abducens.
2. Retrahentes muscles.
2′. Attollens maximus.
2″. Attollens anticus.
3. Temporalis.
4. Nasalis longus.
5. Orbicularis palpebrarum.
6. Levator labii superioris alæque nasi.
7. Dilatator naris lateralis.
8. Orbicularis oris.
9. Zygomaticus.
9′. Buccinator.
10. Depressor labii inferioris.
11. Masseter.
12. Levator humeri.
13. Trapezius cervicalis.
14. Trapezius dorsalis.
15. Latissimus dorsi.
18. Pectoralis parvus.
19. Pectoralis magnus.
20. Sterno-maxillaris.
23. Subscapulo-hyoideus.
24. Antea-spinatus.
25. Teres externus.
26. Postea-spinatus.
30. Caput medium of the triceps.
31. Caput magnum extensor brachii.
33. Extensor metacarpi magnus.
34. Humeralis obliquus.
35. Extensor pedis.
36. Flexor metacarpi externus and medius.
37. Flexor metacarpi internus.
46. Cervical
47. Dorsal serratus magnus.
48. Rhomboideus longus.
49. Superficialis costarum.
50. Splenius.
52. Intercostales.
54. Tensor fasciæ latæ.
55. Triceps abductor femoris.
56. Gluteus externus.
61. Biceps rotator tibialis.
62. Rectus femoris.
63. Vastus externus.
65. Gastrocnemius externus.
68. Flexor pedis perforans.
69. Peroneus.
70. Extensor pedis.
71. Flexor metatarsi.
72. Flexor pedis accessorius.
74. Obliquus abdominis externus.

Voluntary Muscles.—The voluntary muscles are in groups. The first muscle we will call the student's attention to, after removing the skin, is the panniculus carnosus (not shown in Plate I), which is a thin muscle, and almost entirely covering the body, which is sometimes accidentally removed by a careless person in skinning the animal. The action of this muscle is to shake the skin when flies or other objects bother the horse. This muscle is not shown in Plate I it having been removed in order to show the more important ones.

Head Muscles.—At the head there is a group of muscles which assist in chewing, or masticating, the food.

Gullet or Pharynx Muscles.—Around the throat is another set of muscles, sometimes called the muscles of the gullet, or pharynx, which assist in swallowing.

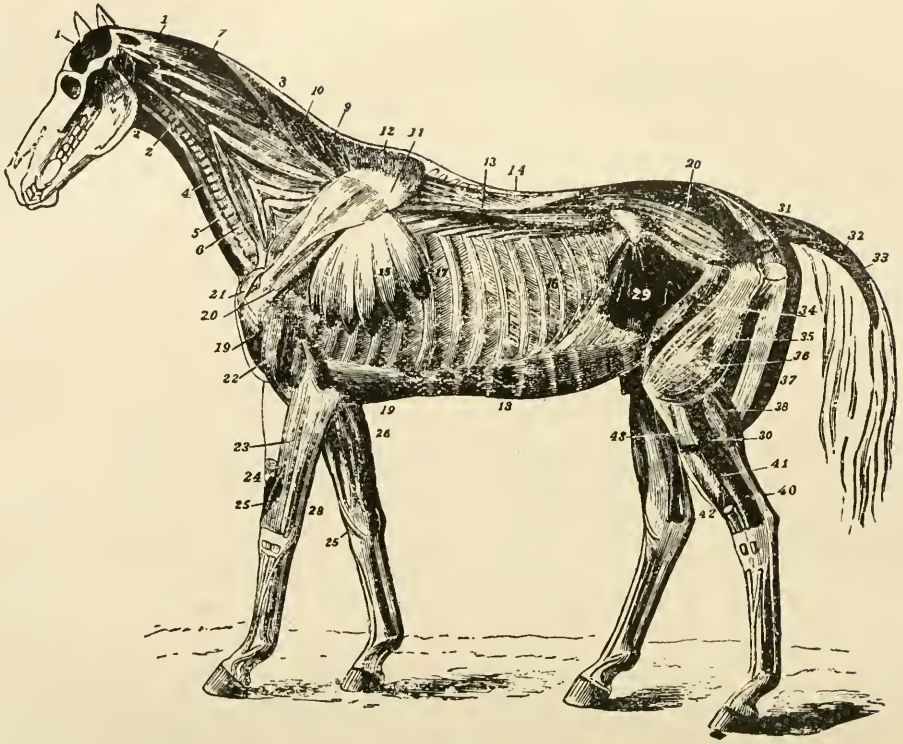
Neck Muscles.—The neck muscles are divided into two groups, one on each side. The action of these is to raise and lower the head, also to turn the neck and head from side to side.

Muscles of the Back.—The muscles of the back are generally divided into two groups, one above the spinal column and the other below. The muscles above the spine assist the animal in running, jumping and rearing. The muscles below the spine are sometimes called the psoae, or lumbar, muscles, situated below the lumbar bones, or the bones of the small of the back. The action of these muscles is to assist the animal in getting up. These muscles are important, for when paralyzed the horse cannot use his hindquarters. Below these muscles are the kidneys.

Hip or Gluteal Muscles.—The muscles of the hip are very large, filling in around the hip bones. The action of these is much the same as those of the back, as they assist in jumping, running, rearing and in flexing and extending the hind leg.

Tail or Coccygeal Muscles.—Here there are four

PLATE III.



MUSCLES OF THE HORSE—DEEP LAYER—AFTER MEGNIN.

EXPLANATION OF PLATE III.

Muscles of the Horse.

Deep Layer.

1. Temporalis.
1. Stylo-maxillaris.
2. Rectus capitis anticus major.
3. Sterno-thyro-hyoideus.
4. Sterno-maxillaris.
5. The Trachea.
6. Scalenus.
7. Splenius.
8. Funicular part of ligamentum nuchæ.
9. Rhomboideus longus.
10. Cervical
15. Costal serratus magnus
11. Cartilage of prolongation.
12. Rhomboideus brevis.
13. Transversalis costarum.
14. Longissimus dorsi.
15. Serratus Magnus.
16. External intercostals.
17. Internal intercostals.
18. Rectus abdominis.
19 19. Pectoralis magnus.
20. Postea-spinatus minor.
21. Flexor brachii.
22. Humeralis obliquus.
22′. Caput parvum (of triceps extensor brachii).
23. Extensor suffraginis.
24. Extensor metacarpi magnus divided.
25. Extensor metacarpi obliquus.
25′. Its tendon.
26, 28. Flexor pedis perforans and perforatus.
29. Obliquus abdominis internus.
30. Gluteus maximus.
31. Erector coccygis.
32. Curvator coccygis.
33. Depressor coccygis.
34. Rectus femoris.
35. Vastus externus.
36. Part covered by triceps abductor.
37. Biceps rotator tibialis.
38. Gastrocnemius externus.
39. Plantaris.
40. Flexor pedis perforans.
41. Peroneus.
42. Flexor metatarsi.
43. Extensor pedis (cut across).

that are important, one situated on the upper side of the tail when straight out, the action of which is to raise the tail; two, one on each side of the tail, have the power of drawing the tail to either side; the fourth is situated under the tail and is the smallest one of the four. Its action is to draw the tail down.

Abdominal Muscles.—The abdominal or belly muscles, are four large, flat muscles on each side of the abdomen. The outer edge of these muscles is attached to the outer ends of the false ribs, also to the processes of the lumbar bones and the outer angles of the pelvic or hip bones. They unite below to what is called the linea alba, a hard, white fibrous cord. They pass back in the center of the belly and are attached to the front of the pelvic bones, called the lower bones of the pelvic cavity. About ten inches from where it is attached here, passing forward, is a small slit or hole, which is called the navel, or umbilical opening. Here the navel vessels pass in and out during the foetus life, or before the colt is foaled. This is a point of importance to note, for sometimes at the time of birth this opening does not close and allows the bowels to come down and form what is known as umbilical or navel rupture.

Before finishing the description of this group of muscles a very large, important ligament should be noted, which is found spread all over the abdomen of the horse. It is of a yellowish color and about one-eighth of an inch thick, attached in front to the back of the breast bone and to the pelvic bones behind. This is the first structure seen after removing the skin from the abdomen. This ligament gives great support to the organs contained in the abdominal cavity. The action, or uses, of the abdominal muscles are to support the organs contained in the abdominal cavity, to flex the backbone and assist in passing of the feces. In the mare these muscles assist in parturition, or foaling.

Shoulder Muscles.—The shoulder muscles are

very large and powerful. There are only three of great importance. Two situated on the outside of the scapula or shoulder blade are important, as they are muscles affected in the disease called shoulder sweeny. The other important one is that which passes down over the shoulder joint through the groove or pulley-like surface on the humerus, or shoulder bone. This is a long, powerful muscle, attached above to the lower end of the scapula, or shoulder blade, passing down through the groove mentioned, and is attached to the upper and front part of the radius or fore arm bone. Its chief point of importance rests in its action in raising the front leg, where it passes over the pulley-like surface mentioned, when it becomes injured or diseased; it is the seat of shoulder joint lameness.

Muscles of the Front Leg.—Muscles of the front leg, from the shoulder down, are divided into two separate kinds, the extensor and flexor muscles. The extensor muscles are those which bring the leg forward. These muscles above are attached to the bones around the elbow joint, passing down in front of the arm bones. About three inches above the knee they become changed into the tendinous part of the muscles, or what is called the cords of the leg. Some of them are attached to the bones about the knee joint, while others pass over the front of the joint and are held down to their place by a band or ligament, forming a loop, as it were, for the tendinous portion of the muscle to glide into when the leg is in action. Each one of these loops through which the muscles pass are supplied with a synovial membrane to secrete the synovia, or oil, which lubricate it during action, the same as in the joint. This is a point of importance, as sometimes, on account of injury or strain of this part of the joint through which the muscles plays there may be found a small, puffy enlargement containing oil secreted by the synovial membrane. This disease is called bursal enlargement.

The flexor muscles are situated at the back part of

the leg, attached above to the back part of the elbow joint, passing downwards at the back part of the leg. About two or three inches above the back part of the knee joint they become tendinous, and from there down to the back part of the coffin bone, where two of the principle muscles are attached; these form what is known as the back tendons, or cords, of the leg. Some of them become attached to the back part of the knee, same as the muscles on the front part of the leg, while the other two principal tendons pass through a loop formed by ligaments, the same as those mentioned in the front part of the knee. In tracing these tendons down from the knee to the fetlock, notice that they pass through another larger loop or sheath formed at the back of the fetlock, where some of the fibers are attached, while others continue down at the back part of the pastern bones, and are attached to the os pedis or coffin bone. These tendons are important, because when they are strained the fact is spoken of as the strain of the back tendons. The action of these muscles is to flex the leg, bend the knee, pastern joints and fetlock.

Muscles of the Hind Leg.—These are also divided into two groups, extensor and flexor. The extensor muscles are situated in front of the hind leg. They are attached above, around the stifle joint, and pass downward in front of the tibia, or thigh bone, one being attached to the front part of the hock. The other passes through sheaths, or loops, supplied by a synovial membrane, formed by ligaments, to hold the muscles firm in front while the leg is in action. In tracing them down, in front of the shin bone to the fetlock, note that they pass through loops, or sheaths, and continue down in front of the pastern bones to where they are attached. The action of these is to bring the leg forward.

The flexor muscles of the hind legs are attached, above, around the back part of the stifle joint. In tracing them down it will be found that they become tendonous. Two of the principal ones pass down to that part of the hock joint, which forms the point known as the

cap. These form what is called the gambe of the leg, and are partly attached at the point of the hock, and other part passing down to the fetlock joint through a loop, or sheath, along the back part of the pastern bones, and are attached to the os pedis or coffin bone of the foot. This muscle, from the hock down, forms one of the back tendons of the hind leg. Another important muscle is found passing down underneath those already mentioned, through a loop, or sheath, at the back part of the hock, where it is supplied with a synovia sac. This is a point of importance, because when it becomes sprained it is the seat of what is called thoroughpin. It then passes down the back part of the shin bone beneath the other tendons already mentioned, through the loop at the fetlock to the back part of the os pedis or coffin bone, where it is attached. The action of these muscles are to flex or bend the fetlock and raise the hock joint in traveling.

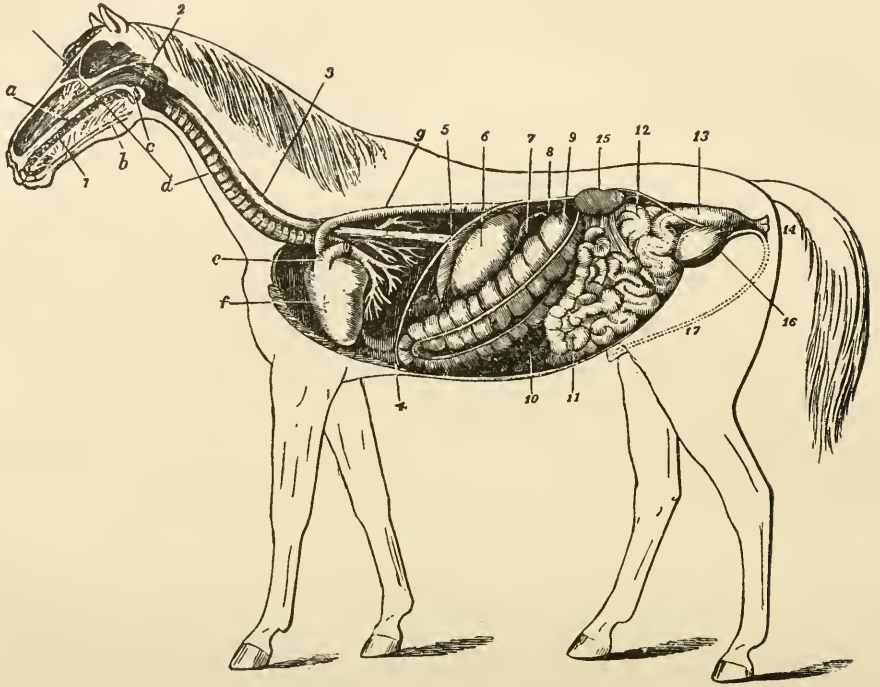
Involuntary Muscles.—Involuntary muscles, or muscles not under the control of the will. The first to notice are those of breathing or respiration. They form a group situated about the chest in such a way as to be the means of increasing or decreasing the size of the chest cavity. When these muscles expand the chest cavity is enlarged, causing the air to rush into the lungs, known an inspiration. On the other hand, when these muscles contract the air is expelled from the lungs, known as expiration.

The diaphragm is a muscular curtain which separates the chest from the abdominal cavity. It also assists greatly in drawing the air in, when it contracts. This muscle also assists in passing faeces, and in the mare foaling. It separates the heart and lungs from the bowels, liver and stomach. This muscle should be carefully examined by the students. It can be seen by opening any dead animal.

There is one muscle which is both voluntary and involuntary. It is situated in the penis, surrounding the urethra, or the tube, which carries the urine from the

bladder to the penis in the male animal. Its action is voluntary while the animal is passing urine. It is involuntary during sexual intercourse, forcing the semen down through the penis.

PLATE IV.



DIGESTIVE AND MALE URINARY APPARATUS OF A HORSE—AFTER MEGNIN.

EXPLANATION OF PLATE IV

Digestive Apparatus of the Horse

1. Mouth.
2. Pharynx.
3. Œsophagus.
4. Diaphragm.
5. Spleen.
6. Stomach (left sac).
7. Duodenum.
8. Liver (upper extremity).
9. Great colon.
10. Cæcum.
11. Small intestine.
12. Floating colon.
13. Rectum.
14. Anus.
15. Left kidney and ureter.
16. Bladder.
17. Urethra.

a. Hard palate.
b. Tongue.
c. Soft palate.
d. Trachea.
e. Pulmonary artery (divided).
f. Heart.
g. Posterior aorta.

CHAPTER IV.

SPLANCHNOLOGY.

Study of large interior organs in any of the four great bodily cavities especially those in the abdomen.

Digestive Organs of the Horse.—The digestive organs comprise the alimentary canal and the accessories by which the alimentary matter is received and subjected to specific actions, which adapt it for purposes of nutrition. Digestion, therefore, embraces the collective operations and changes which the food undergoes in the alimentary canal.

The whole digestive track from the mouth to the anus which is situated just below the tail, is sometimes called the alimentary canal.

The mouth is an oval cavity at the commencement of the alimentary or digestive canal. In front of the mouth are the lips, one above and one below; at the sides are the cheeks. The mouth is lined with what is known as the mucous membrane, in which are several small openings, from the glands, which are situated about the mouth. Through these the saliva is poured. On the upper part of the mouth the mucous membrane is thrown into ridges, or folds, from 18 to 20 in number. This is a point of importance in connection with bleeding a horse with lampas. It is never safe to bleed back of the third bar because there is a large artery which runs down through the roof of the mouth and enters the hole in the bone just before it reaches this bar. The tongue, which has the chief nerves of the sense of taste, is situated in the mouth; this organ also has a very important part to perform in masticating the food and mixing it with saliva. The teeth, which also take a very active part in

the masticating of food, are dealt with under the heading of "Teeth."

Salivary Glands.—These glands secrete the saliva that is poured into the mouth while the animal is eating. There are only three pairs of much importance. One large pair, one on each side of the throat below the ears, known as the parotid glands, fill up the space between the jaw bone and the neck. This pair has tubes passing around and under the lower jaw and up into the cheek muscles entering the mouth opposite the fourth molar tooth. These tubes, known as steno's ducts are about an eighth of an inch in diameter and convey the saliva from the glands into the mouth. The next pair are situated under the pair just mentioned. Their tubes enter into the bottom part of the mouth. The third pair are situated under the tongue, one on each side. They pour their secretion into the mouth by several small openings near the front under the tongue. This can be seen by examining the under surface of the tongue closely. This is very important fluid in connection with the digesting of the food.

The gullet is a cavity situated just back of the mouth. It is chiefly made up of muscles which perform the act of swallowing the food. It is lined with the continuation of the mucous membrane of the mouth.

The oesophagus, or the continuation of the gullet, is a tube extending from the gullet to the stomach, and is used to convey the food to that organ. It is made up of two coats, the muscular and the mucous. The former contains fibers which, when once the food enters the tube, contract behind it, forcing it down to the stomach. Its lining is a continuation of the mucous membrane of the mouth and the gullet. In tracing the oesophagus or tube down the neck from the gullet, note that it passes down the left side of the neck, entering the thoracic, or chest cavity, between the lungs over the heart through the large muscular curtain known as the diaphragm, then

enters the stomach an inch or two after passing the diaphragm.

The Stomach.—This organ is very small in the horse in comparison with that of the ox. It holds only about four gallons, and is situated just back of the curtain which separates it from the lungs. It lies mostly to the left side. The walls of the stomach being composed of three coats. That on the outside is called the serous membrane, a name applied to membranes which line closed cavities, such as the abdominal cavity. The inside lining is a continuation of the mucous membrane lining the organs before mentioned. The lining in the left part of the stomach or the part where the food is prepared for digestion is the same color as that of the mouth. The lining of the right part of the stomach, which is the true digestive part, is of a deep red color resembling velvet, and when placed under a microscope has the appearance of a honey-comb. When the stomach is empty this membrane is thrown into loose folds. Several small openings may be noticed through which the gastric juice and pepsin from the glands, situated in the walls of the stomach, enters. These are very important fluids as they assist greatly in digesting the food. The third coat is known as the muscular coat already mentioned. Its action is to give the stomach a churning motion, rolling the food around and mixing it with the juices. The opening to the stomach is guarded by a valve which prevents the food from passing back through the gullet. There is also a valve at the opening of the bowels, preventing any coarse, undigested food from entering them. The stomach is held in its place by five large ligaments, and is well supplied by blood-vessels and nerves. Digestion of the food takes place very quickly in the horse in comparison to other animals. Frequently a change of food or working too soon after eating will interfere with the digestion, thus setting up what is known as indigestion. This is a very painful disease in the horse. After the food is acted upon by the juices in the stomach it changes

into what is known as chyme, which passes into the bowels.

The Bowels.—They are divided into two parts—the large and small.

The small bowels are 72 feet in length, about one inch in diameter, and are made up of three coats, same as the stomach. The serous coat on the outside contains small glands which secrete an oily material to lubricate the outside of the bowels, which comes in contact with the inner wall of the abdominal cavity. The muscular coat, made up of muscular fibers, is situated between the other two coats, the same as in the stomach; its action is to contract the bowels, giving them motion to convey the food along through them. The mucous coat is a continuation of the mucous coat of the stomach. Along this coat are found small glands known as villi lacteal; these absorb the nourishment from the food as it passes along through the bowels and pours it into the blood. The small intestines or bowels are attached on the upper side to what is known as the mesentery, which is attached above to the roof of the abdominal cavity. It can be seen in any of the smaller animals upon examination. About six inches from the stomach, in the bowels, are found two openings. One of these receive the heapitic duct, a tube for the purpose of carrying the bile from the liver to be poured in on the food as it passes through the bowels. The other opening is for the duct of the gland known as the pancreas. It secretes a clear fluid known as the pancreatic juice. These juices act on the food in the first part of the small intestines, changing it into chyle. After this, the action of the rest of the intestines is to absorb the nourishment out of the food as it is passing back. The small intestines and stomach, when in a healthy condition, should be found empty one hour after food has been eaten. The small bowels or intestines are situated mostly on the left side just behind the stomach.

The large bowels have three coats, the same as the small ones. The first part of the large bowels is known

as the blind bowel or caecum, and is about three feet in length; this is generally the first thing to protrude when opening a horse's abdominal cavity. Its use is to act as a reservoir to hold the water and fluid of the food; from this organ the water and fluid parts are mostly taken up into the system. The next part of the large bowels is known as the large colon; it lays along the floor of the abdominal cavity, is about nine feet in length and is doubled on itself three times. In this bowel the solid part of the food is found. Here digestion is brought about by the contraction and expansion of the muscles of the bowel and the nourishment taken from it, after which it is worked back out of this bowel and enters what is known as the floating colon. This is about ten feet in length and about two inches in diameter, or double the size of the small bowel. It is thrown into folds or pleats, and as that portion of the food containing no nourishment passes through it is worked into balls which pass back and are emptied into the rectum or back bowel. This is situated at the back part of the abdominal and pelvic cavity back of the small bowels or intestines and like them, is suspended by a fold paritoneum.

The rectum or back bowel is sometimes known as the straight bowel. It is about 18 inches long and forms the last part of the bowels or intestines. Its coats are a continuation of those of the large bowel, but each is thicker and heavier. Above this bowel are the bones of the sacrum, below it, in the horse the bladder and other small glands. Below the rectum of the mare are situated the womb and the vagina, the latter being the passage into the womb from the outside. The bones which help to form the pelvic cavity are situated at the sides, and at the back immediately under the tail is what is known as the annus. The use of the rectum is to hold the balls as they pass back from the floating colon. When the rectum becomes so full that there is pressure on the sides of the wall thus stimulating the nerves the muscular coat contracts and forces the contents back towards the

annus. At the same time the muscles of the annus dilate, causing the faeces to pass out.

Accessory Organs of Digestion.—In the abdominal region these organs are the Liver, the Pancreas, and the Spleen.

The Liver is the largest gland in the body and is situated between the stomach and the diaphragm. The liver of the horse weighs from ten to twelve pounds. It is of a dark brown color, well supplied with blood and nerves, and is held in place by several strong ligaments. A bitter, greenish colored fluid called the bile is secreted from the liver and emptied into the digestive system, where it plays an important part in its action on the food. There is no gall bladder in the horse, but simply a tube passing from the liver to the small bowel into which it empties the bile about six inches back of the stomach. It is important to note that it is in this tube that gall stones sometimes collect.

The Pancreas is another very important gland. It is of a grayish, fatty color, and may be found near the roof of the abdominal cavity in front of the kidneys. The Pancreas secretes a clear, colorless fluid called the pancreatic juice. This fluid, like the bile from the liver, also plays an important part in the digestion of food. It is carried down from the Pancreas by a duct or tube emptying into the small bowel just back of that of the liver.

The Spleen is a long, flat gland about fifteen inches in length, situated along the left side of the stomach and to which it is closely attached. It is of a grayish red color and feels quite soft. It is ductless, there being no secretion passing from it. The function of this gland is not clearly understood, but by many it is supposed to regulate the temperature of the stomach during the process of digestion and to act as a reservoir for the blood. Some speak of it as the burying ground of the red corpuscles. It is well supplied with blood vessels and nerves and weighs about two pounds in an average sized horse.

RUMINANTIA.

Digestive System.—The lips of an ox are thick and hard. The upper has no hair on it and varies in color with the color of the animal. When cattle are in good health this space is always moist.

The cheeks on the inside are covered by many small rough processes, which give them a very rough appearance.

The Tongue of the ox is stronger than that of the horse and is more movable. It is very thick and heavy at the back, pointed at the front end and the upper part of it is very rough. It is by means of the tongue that the ox takes most of the food into the mouth.

The Salivary glands are similar to those of the horse.

The Teeth differ very much from those of the horse.

The ox has no front teeth in the upper part of his mouth, their place being taken by a pad of cartilage or gristle. This pad takes the place of the upper row of front teeth. The lower row of teeth press against it when the animal is cropping grass. This accounts for the fact that cattle do not do as well on short grass as horses.

The front teeth in the lower jaw also differ from those of the horse. They are eight in number, chisel-shaped, and are loosely set in the gum.

The molars, or back teeth, are similar to those of the horse, only they are smaller and not so smooth on their upper surface. The ox has twenty-four molars or back teeth, and eight incisors or front teeth, making thirty-two in all.

The Gullet of the ox is much larger than that of the horse.

The Oesophagus or tube, which carries the food down from the mouth to the stomach is well developed, the fibers in it being very strong and possessing a double action. When the animal is eating they carry the food from the mouth to the stomach, and when chewing the

cud they act the very opposite, carrying the food from the stomach back into the mouth.

The Stomach.—The student will do well to give some time to the study of this important organ of the ox, as it is very frequently the seat of disease.

The stomach has a capacity of fifty-two gallons and is divided into four separate and distinct compartments: the Rumen or Paunch, the Reticulum or Honey Comb, the Omasum or Many-plies, and the Abomasum or the true Stomach. In the first three of these the food undergoes a sort of preparatory process, while in the fourth the process of digestion is complete.

The Rumen or paunch is very large, and in an aged animal fills three-quarters of the abdominal cavity. It lies up against the left side of the wall of the abdomen, where it is attached and held to its place by the ligaments. Its situation being an important matter, as many diseases of the rumen, or paunch, are first noticed on the left side. Tapping for bloating is always done on the left side because of this fact. The walls of the paunch of an ox resemble those of the stomach of the horse, but are not so sensitive, and stand a great deal of abuse before inflammation sets in. The paunch has two openings, both of which are at the front; through one the food enters, while through the other it passes out into the next division.

The Reticulum, or honey comb, is the smallest division and resembles a honey comb in appearance. This part has little to do with preparing the food. It is provided with two openings, one in front, where the food enters, the other at the back, where it passes through into the third division. In the reticulum, or honey comb, the food is softened further by the water that the animal drinks which passes directly into the second division. The food is here pressed into balls and prepared to be forced back into the mouth to be further masticated.

The Omasum, or many-plies, is the second largest division of the stomach. When full it is ovoid in shape.

It is placed just behind the second division and at the right side of the paunch. The inside is full of folds, or layers of membrane, into which all the coarse parts of the food pass and roll about until it is fine and well prepared to pass into the last division. When this part of the stomach becomes deranged and the food becomes dry and hard between the folds, the disease called impaction of the many-plies, or dry murrain, is the result.

The Abomasum, or fourth stomach, is the true digestive part. In it the food is completely digested. The walls are redder in color than those of the three first divisions and contain the glands which secrete the acids and gastric juices. This stomach has two openings, one through which the food enters and the other through which it passes into the small bowels.

The Bowels, or intestines, of the ox are divided into large and small bowels. This, together with their structure and action resembles that of the horse. The small bowels are only half the size of the horse, being about one-half inch in diameter, and about one hundred and fifty feet in length. The large bowels are not nearly so long as those of the horse and are thirty-five feet in length.

The Liver of the ox resembles that of the horse, except that it is provided with a gall bladder which resembles a pear in shape. This acts as a sac in which to store the gall during the time it is not required in digestion. When digestion is going on the wall of the gall sac contracts and forces the gall down to the food. The other glands, the pancreas and spleen, resemble those of the horse. The juices from these glands have the same action in cattle as they have in the horse.

Rumination, or Chewing the Cud.—Food when first taken into the mouth of a ruminant is but lightly masticated and mixed with the saliva from the salivary glands, after which it is swallowed, passing through the oesophagus into the rumen or paunch (first stomach). This division acts as a reservoir or storehouse for food

thus eaten quickly. When the animal has time, so to speak, he lies down or stands quietly and completes the process of mastication of his food by chewing the cud. This peculiar act is performed as follows: After being softened and mostened by warmth, the food passes from the rumen or paunch into the second division—the reticulum, honey comb or second stomach. In this small globe-like compartment the food is moistened and compressed into pellets—the cud. By a peculiar reverse action of the oesophagus or gullet these pellets are taken back into the mouth for further mastication or chewing. When re-mastication is completed it is again swallowed, but this time it passes directly into the omasum, manyplies or third stomach, and thench to the fourth or true stomach.

Process of Digestion After Rumination.—Following rumination which, strictly speaking, is the first step in the digesting process, the food passes into the third stomach. The fine parts pass right along to the fourth stomach while the coarser parts are drawn between the folds of the membrane in this division and worked about until it is fine and ready to pass into the fourth stomach, where it becomes fully digested by the action of acids and gastric juices which are secreted in this part. It then passes into the small bowels, and is acted upon by the bile from the liver and the pancreatic juice from the pancreas. These juices are emptied into the first part of the small bowels through little ducts or tubes, which lead from the glands down to the bowels, just on the same principle as that of the horse. After this, throughout the rest of the bowels, the nourishment of the food is taken into the system by means of little glands which are situated in the coating of the bowels. The nourishment when once in the blood goes to supply the different parts of the body, while the part containing no nourishment or undigested passes off through the back bowels in the form of feces.

TEETH.

Teeth are objects situated in the upper and lower jaws. They are made of the same tissues as bone but contain 10½ per cent. more of earthy salts. This fact accounts for their extreme hardness. Unlike bone they can stand exposure to air and friction without becoming diseased. Teeth are used to masticate or chew the food, and because of the constant change in their formation and appearance they serve as a guide in telling the age of the horse.

There are three hard structures that enter into the formation of the teeth—Dentine or Ivory, Enamel, and Cementum, or Crusta Petrosa.

The Dentine, or ivory, is situated in the upper part around the pulp or nerve cavity. It is of yellowish color and largely supplied with nerves which pass through it from the pulp cavity.

The Enamel is the hardest substance of the tooth, and covers the outside of all the exposed part. This substance is characterized by its whiteness and, unlike the dentine, contains no blood vessels or nerves. If part of the enamel is broken off it is never replaced, and the tooth below the broken part generally becomes decayed.

The Cementum, or crusta petrosa, is found in the fang or root and the parts situated below the gum. It is the softest part of the tooth.

Teeth may be simple or compound. Simple as in the dog, where the entire exposed surface is covered by a solid cap of enamel, which alone is in wear; compound or complex, as in the horse, where various tissues are in wear. A tooth consists of the following anatomical parts: The body, or crown, that part above the gum; the table, the part that comes into wear on the top; the neck, the part to which the gums are attached; and the fangs or roots, the parts situated down in the bone.

There are three kinds of teeth found in the horse, the incisors, the canine and the molars.

The Incisors, or front teeth, situated in the front part of the mouth just inside the lips, are twelve in number, six above and six below.

The Canine, or bridle teeth, are often absent in the mare. They are four in number, two in the upper and two in the lower jaw, one on each side about two inches back from the incisor teeth. They are from a quarter to three-quarters of an inch above the gum, are round and pointed and of no particular use. They resemble the eye teeth of other animals.

The Molars, or back teeth, are twenty-four in number, six on each side in the upper and six on each side in the lower jaw. With these the food is ground and masticated.

Wolf Teeth are two small, round, pointed temporary teeth which vary in size in different animals, situated one on each side in front of the molars or back teeth in the upper jaw.

Temporary and Permanent Teeth.—The horse has two sets of teeth. The milk are temporary and are those that the colt sheds; while those that come in and remain without being shed are called the permanent teeth. The cutting of the teeth of the foal varies, but at or within nine days after birth he has four front teeth, two in the center above and two below, and in the back part of the mouth twelve molars. At from seven to nine weeks four more incisors or front teeth appear, one at each side of the two center teeth in each jaw. At nine months he gets the last of his milk or temporary teeth, these being the corner teeth, two in the upper side and two in the lower side of the jaw. At this time he has his full set of milk temporary teeth, consisting of twelve molars or grinders and twelve incisors or front teeth, six above and six below, making twenty-four in all. As the colt advances in age he sheds all these teeth. He then

commences to get permanent teeth. When the age of one year is reached, four permanent molars appear, two in each jaw, one on each side, behind the three temporary teeth. At two years of age he gets four more back molars, one on each side of each jaw. When the age of two years and nine months is reached the two middle teeth of the temporary incisors, or front teeth of each jaw fall out, and are replaced by two permanent incisors in each jaw; thus at the age of three years these four permanent incisors are up and in wear. At this age, the first eight molars, two on each side of each jaw, are shed and replaced by eight permanent molars. At four years of age he sheds four more front or incisor teeth next to those shed at three years, and these are replaced by four more permanent incisors or front teeth. At this age, too, he sheds the four remaining temporary molars, or grinders, which are replaced by four more permanent molars. He also gets four more permanent molars at the back of the mouth. Thus at the age of four years the colt has a full set of permanent molars, consisting of six on each side of each jaw, making twenty-four in all. At five years of age he sheds the four remaining temporary incisors or front teeth, which are replaced by four permanent incisors, known as the corner teeth. It is important to become familiar with the time at which the colt sheds his different teeth, for sometimes the caps or shells of the teeth do not fall off when they should. These should be watched, for they greatly interfere with feeding and should be removed with forceps. At five years of age the canine or bridle teeth make their appearance; thus at the age of five years the colt has all his teeth or what is known as a full mouth.

The following table shows the various changes tak-

ing place in the mouth of the horse from the time of birth up to the age of five years:

Hence the horse has—

Age	—Incisors— Tempo-rary	Perma-nent	Canine	—Molars— Tempo-rary	Perma-nent
At or soon after birth.....	4	0	0	12	0
9 weeks	8	0	0	12	0
1 year	12	0	0	12	4
2 years	12	0	0	12	8
3 years	8	4	0	4	16
4 years	4	8	0	0	24
5 years	0	12	4	0	24 =40

The table given below indicates the various changes which occur in the mouths of ruminants, and more particularly in the mouth of the ox:

RUMINANTS

Age	—Incisors— Tempo-rary	Perma-nent	Age	—Molars— Tempo-rary	Perma-nent
At or soon after birth	4	0	....	12	0
2 weeks	6	0	1 year	12	4
3 weeks	8	0	2 years	8	12
2 years	6	2	3 years	4	16
3 years	4	4			
4 years	2	6	4 and 5 years..	0	24=32
5 years	0	8			

A table giving the number and variety of teeth as they occur in the domestic animals and in man may be serviceable as one of handy reference, and is herewith appended:

	Incisors	Molars	Canine	Bicuspid	Total
	4	6	2	4	
Man	—	—	—	—	= 32
	4	6	2	4	
	6	12	2	0	
Horse	—	—	—	—	= 40
	6	12	2	0	
	0	12	0	0	
Ox	—	—	—	—	= 32
	8	12	0	0	
	6	12	2	0	
Dog	—	—	—	—	= 42
	6	14	2	0	
	6	14	2	0	
Pig	—	—	—	—	= 44
	6	14	2	0	
	6	8	2	0	
Cat	—	—	—	—	= 30
	6	6	2	0	

The dental formula of the ox is the same as that of all ruminants.

RESPIRATORY SYSTEM OF THE HORSE.

Organs of Respiration.—By the action of these organs certain chemical and physical changes take place in the blood, the chief of these consisting of absorption of oxygen form, and giving off carbonic acid to the atmospheric air, the former change being necessary for the elaboration of the fluid, the latter for the elimination of a substance which, if retained, would prove injurious. The organs of respiration are invariably adapted to the wants of the animal and the medium in which it lives. Thus insects breathe by air-tubes, opening on the surface of the body; in the oyster breathing is performed by fringes; in fishes by gills; in the mammelia by means of elastic air-receptacles, called lungs, which are enclosed in special cavities, and communicate with the atmosphere by means of an air-tube.

In the horse, who breathes only through his nose, the organs of respiration are the nostrils, nasal-chambers, larynx, trachea, and in the thoracic cavity, the bronchi, bronchial tubes, and the lungs.

Nostrils.—The nostrils are two openings, one on each side of the nose. They are held open by the aid of cartilage and muscles. About one and one-half inches up the nostril on the under side is a small opening about the size of a grain of shot. Through this opening the duct or tube which carries the tears down from the eyes empties into the nose. The nostril is lined with a thin, delicate skin which changes into mucous membrane as it passes up into the chambers of the head.

Nasal Chambers.—These give passage to the air from the nostril into the larynx. There are two of these chambers, divided in the center by a thin partition or cartilage called the septum nasi. These communicate with the sinuses of the head. The horse cannot breathe through the mouth on account of the formation of the

throat, and this compels him to always breathe through the nostrils. This is a point which should be remembered.

Larynx.—This is a cavity made of cartilage. It gives passage to the air and also the organ of voice. It is situated in the floor of the gullet. This cavity has an opening on its upper side, guarded by a valve, which is always opened except when the animal is swallowing food or water. When the food is being swallowed it passes over the valve which closes the opening while the food passes over it. This is important, for if the valve does not close properly, thus allowing either food or water to drop into the windpipe, the animal will have a fit of coughing. This is sometimes referred to as "the food going down the wrong way." On the outside of this cavity of cartilage are found several small muscles which help to hold it in its place. It is lined inside by a continuation of the same membrane as that of the chambers of the head. The vocal cords which come into play when the animal is whinnying are found along the inside of this cavity. These cords are not nearly so well marked as in the human being, and if they or the cartilage of the larynx become affected it generally gives rise to the disease called wind-broken or roaring.

Trachea (Windpipe).—This is a tube which conveys the air down from the larynx to the bronchial tubes in the lungs. It is made up of forty or fifty rings of cartilage which are united to each other by strong elastic ligaments. They give to the windpipe its flexibility, that is, the power to bend in any direction almost like a piece of elastic. From the larynx the windpipe enters the chest where it terminates into two small tubes, one going to the right lung and one to the left. These are called the bronchial tubes.

Bronchial Tubes and Air Cells.—These are made up of the same material as that of the windpipe, but are only about half the size. After passing into the

substance of the lungs they break up into small tubes which pass all through the lungs and terminates into what is known as the air-cells. These small tubes and air cells are lined inside by a very thin mucous membrane, a continuation of the membrane lining the other organs already mentioned. Just inside this thin mucous membrane is found the capillary network of the lungs, and while the blood is slowly passing through this network of vessels it gives off to the air in the air cells carbonic acid gas and takes in the oxygen from the pure air while it is in the lungs.

Lungs.—Lungs are the most important organs of respiration. They are spongy, yellowish organs, two in number, one situated on the right side, and the other on the left. The right lung is the largest because of the left one having a hollow in its side for the heart. The lungs are separated by a partition known as the mediastinum, by the heart which is in the folds of this partition, and also the large blood vessels and oesophagus. They are made up of light elastic tissue and are full of air cells and tubes. While the animal is alive they are very large and fill up nearly the whole chest cavity, but after death they collapse and are not nearly so large. Between the lungs and the ribs is found a serous membrane called the pleura or the lining membrane of the chest. It is made up of two folds, one being attached around the outer surface of the lungs, while the other is attached to the ends of the ribs at the side and at the back to the large curtain which separates the lungs from the bowels. The little glands situated in this membrane secrete an oily fluid which serves to lubricate these parts while the lungs are working in the chest so as not to cause friction. When this membrane becomes inflamed from a chill or injury it sets up the disease called pleurisy.

Respiration.—The number of respirations per min-

ute varies with the different classes of animals; as a rule, the larger the animal the slower the respiration.

The horse	8 to 10
Cattle	12 to 15
Sheep and goats	12 to 20
The dog	15 to 20
Swine	10 to 15

The rate of breathing is increased from the process of digestion immediately after eating, or may increase from exercise.

RESPIRATORY SYSTEM OF THE OX.

The nostrils are narrow and capable of little dilation compared to those of the horse. The nasal chambers differ chiefly in there being an additional turbinated bone. The nasal chambers communicate with the mouth, therefore cattle can breathe through the mouth to a certain extent. The larynx is simpler in construction, the true vocal cords being only slightly developed. The trachea or windpipe presents no important variation. We may note the presence of a third bronchus, which passes to the right lung to supply a lobe which is wanting in the horse.

The Thoracic Cavity is relatively smaller in the ruminants, and the pleurae present a very important deviation from the arrangement found in the solipede—viz., the back or posterior mediastinum is imperforate and strong, completely separating one pleural sac from the other. This arrangement exists in all the domesticated mammals but the solipede. The left lung is divided into two lobes, the right into four, the front one recurving over and almost covering the front of the heart. The interlobular or cellular tissue is exceedingly thick, the separation between the lobules being distinctly visible. This arrangement explains perfectly the special nature of pneumonic lesions in the large ruminants.

URINARY SYSTEM OF THE HORSE.

The organs of this system secrete the urine from the blood, and excrete or expel it from the body. These organs are chiefly the kidneys, ureters, bladder and urethra. The urine, which is a watery fluid, is secreted by the kidneys, and carried off by their ducts, the ureters, to a special reservoir, the bladder, where it accumulates and from which it is finally expelled at intervals through the urethra.

The kidneys are two compound tubular glands, one on the right side and one on the left side, and are situated just below the small of the back (sublumbar region), the right one being the fartherest ahead. In shape they are long and narrow and resemble the liver in color. In cutting one of the kidneys open, it is found to be full of glands and tubes, which secrete the urine from the blood while it is passing through the kidneys. These tubes pass to the center of the kidneys, where they empty the urine into what is called the pelvis. The glands are largely supplied with blood vessels and nerves. The use of the kidneys are to secrete the urine from the blood, which contains a large amount of what is known as ureaic acid, and if not taken out of the blood by these glands, acts as a poison to the system.

The Ureters are tubes which carry the urine down from the pelvis of the kidney to the bladder. They are two in number, one situated on the right side of the pelvic cavity and the other on the left side, close to the walls—they enter on each side at the upper surface of the bladder. They are only about one-sixteenth of an inch in diameter.

The Bladder is situated in the pelvic cavity. When it is full it sometimes stretches out into the abdominal cavity. It consists of a body and neck. The body is the large part, and is placed in front; the neck being at the back part of the bladder. This is where the urine passes out of the bladder. The bladder is made up of

three coats, somewhat similar to that of the bowels. The serous coat is a continuation of the serous coat found in the abdominal cavity lining the bowels. The inside is lined with mucous membrane which is thrown into folds when the bladder is empty. Another coat is found between the two membranes above mentioned, called the muscular coat, the action of which is to contract the bladder when the animal wants to urinate. The bladder is held in by ligaments. The rectum lies above the bladder, which in the horse rests on the floor of the pelvic cavity. Its position in the mare differs from that of the horse. Instead of the rectum or back bowel being immediately above it, as in the horse, the womb is just above the bladder or between it and the rectum. The bladder acts as a reservoir in which to store the urine until it is full; it then presses on the walls and nerves, giving a peculiar sensation to these parts, causing the walls to contract, forcing the urine into a tube which carries it from the body. This is called the urethra. The neck of the bladder is simply an opening at the back part, and is guarded by a valve which prevents the urine from dripping out except when the animal is passing its urine or water.

The Urethra is the tube which carries the urine from the bladder out of the body. It is situated much differently in the mare than in the horse. In the mare it is very short, passing from the neck of the bladder along below the womb and vagina, which is the passage from the outside into the neck of the womb. It opens up into the underside of this passage about four inches in from the outside. This opening is guarded by a small, thin valve, and can be felt by passing the finger along the under side of the passage which leads into the womb. In the horse this tube is a great deal longer than in the mare. It commences at the bladder, passes along below the rectum or back bowel to just below the anus. Here this tube bends downward and forward and passes into the penis, continuing down to the end where it terminates. Its purpose is to carry the urine from the bladder

out of the body and to perform certain actions in connection with the genital organs. Its lining is a continuation of the membrane of the bladder.

URINARY ORGANS OF THE OX.

The chief difference in these organs occurs in the kidneys, which in the ox are larger, and in place of being smooth, like those of the horse, are rough, resembling a bunch of grapes. The bladder and the urinary organs resemble those of the horse.

GENERATIVE SYSTEM OF THE HORSE.

Animals possess the faculty of reproducing or propagating their species, and this function may be nonsexual or sexual, the former being confined to certain lowly-organized classes of animals.

In all the higher animals the generation of a new being is dependent upon two individuals, a male and a female, the female furnishing a germ, or ovum, the male a fecundating fluid, or sperm, which animates the germ and renders it fit for development.

Both the ovum of the female and the sperm of the male are secretions of glands, which are termed the genital glands, male and female; and in either sex the generative system may be said to consist of these glands, with certain accessory organs. The act of coition brings the two secretions into contact.

We have two systems of genital organs to consider —the male and the female.

Male.—The genital organs of the horse are as follows: The scrotum or bag, the testicles, the spermatic cord, the vesiculae seminales or pouches which hold the semen or sperm, the urethra, the penis and the sheath.

The Scrotum is a sac or bag which contains the testicles. It is situated between the hind legs, and is cov-

ered on the outside by a very fine, soft skin. Passing up in the center under the sheath the scrotum is a well marked line in the skin called median raphe. This can be plainly seen when the horse is on his back. It continues up, gradually getting fainter until it reaches the anus. Under the skin are layers of white fascia or tissue which can be seen by cutting through the scrotum. There is a partition in the scrotum separating the two testicles. The size of the scrotum is affected very much by the weather. In cold weather its fibres contract, causing it to get very much smaller, while in warm weather the fibres relax, causing it to become very much larger. The scrotum contains, supports and protects the testicles.

The Testicles are the glands which secrete the semen or sperm. They are two in number, one situated on the left side and the other on the right. They are oval in shape, and are attached above to the spermatic cord. Before the animal is born the testicles are situated in the abdominal cavity and attached to the serous membrane which has already been spoken of in connection with that cavity. At or about the time of birth, there takes place what is known as the descent of the testicles into the scrotum. In their downward course they pass through a slit or small opening at the back part of the muscles of the abdomen, where they are attached to the under part of the hip bone. These slits or openings are known as the inguinal rings. They can be felt in the horse by pressing the fingers well up into the groins. The descent of the testicles is an important point to remember. If the testicle does not descend into the scrotum the horse is known as a ridgling. In this case the testicle is not found in the scrotum. At the front part of the testicle there is a small ridge called the globus major and at the back of it is another smaller ridge called the globus minor. Passing between these two ridges is another well marked ridge called the epididymis. These can be easily seen by examining the testicle

after the animal is altered or castrated. The substance of the testicle is made up of small glands and fine tubes.

These tubes, as they pass towards the back of the testicle, form into larger tubes and finally unite to form one called the vas deferens.

The Spermatic Cords, or the cords of the testicles, are attached above to the inguinal rings or openings mentioned before. They are about five or six inches long and have the testicles attached to them below. In each cord is found a small muscle which goes by the name of the spermatic muscle, the rest of the cord being made up of the spermatic artery, veins and nerves. Running up at the back of these cords is found a tube called the vas deferens. Around the spermatic cords and testicles is a serous membrane, one layer being attached to the testicle and cord, while the other is closely attached around the inside of the scrotum. In this membrane are small glands which secrete an oily fluid to lubricate the parts, preventing friction when they are jolted about in the scrotum. This fluid flies out as soon as the scrotum is cut. This is important, because sometimes from a slight injury the glands will secrete a large amount of this fluid, thus causing the scrotum to look large and swollen. This disease is known as hydrocele or water in the scrotum.

Vas Deferens.—These tubes are two in number and are situated just behind the spermatic cords. They are about an eighth of an inch in diameter and quite hard. They carry the semen up the back part of the spermatic cord through the inguinal rings, before mentioned. They pass backward and upwards, one on each side, to the upper part of the bladder, where they empty into two small pouches or sacs, called the vasiculae seminales. These store up the semen as it is secreted by the testicles, and when full present the appearance of a pear.

Vesiculae Seminales.—These sacs or pouches are situated at the upper side, over the neck of the bladder, one on each side. They have the vas deferens emptying

into them at the front end, while at the back end of each is a small opening that leads out into another small tube which passes backward and empties into the urethra, mentioned before as carrying the urine out from the bladder. These sacs or pouches store up the semen or sperm of the horse. During sexual intercourse, these pouches contract and force the semen through the little tubes mentioned out into the urethra, leading down through the penis.

The Penis is the main organ of sexual intercourse. Its substance is formed of what is known as erectile tissue, which under certain circumstances becomes enormously distended with blood. Passing up the under side there is, what has already been mentioned, the urethra, or the tube, which carries the urine out of the body, and also in the act of intercourse carries the semen. This is used for two purposes, as we have already mentioned.

The Sheath is a loose process of skin which passes downward from the scrotum, generally from about five to six inches, according to the size of the animal. It is attached to each side, leaving a hole or opening in the center through which the penis passes. The outside of the sheath is covered by a thin, delicate skin similar to that of the scrotum. It is lined inside by a membrane containing many small glands, which secrete a thick, dark fluid to lubricate this passage. Sometimes this fluid collects in here and has the appearance of tar. This is important, for when it collects to a large extent the sheath should be washed.

The Semen or sperm of the horse is a light fluid, which, when examined under a microscope is found to contain small objects called spermatozoa. These move about, and when in the womb meet the ovum of the female, which is secreted by a gland called the ovary. When these two small objects unite, they form the foetus, or what may be called the animal in its first stage of development.

FEMALE GENITAL ORGANS.

The female genital organs, or the organs of the mare, are very much different from those of the horse. They are known as follows: The ovaries, the fallopian tubes, or tubes which carry the ovum from the ovaries to the uterus or womb, the uterus or womb, the vagina, and the vulva.

The Ovaries in the mare correspond to the testicles in the horse. Each is about the size of a pigeon's egg, and resembles it much in shape. They are held in place by ligaments, and at the back part are provided with tubes leading from them called the fallopian tubes. The ovaries secrete the ovum or germ. This is a very minute body, which, when examined under the microscope, is found to be only 1-150 of an inch in diameter.

The Fallopian Tubes are two canals, one on each side. They pass backward and upward, and enter the front part of the uterus or womb. These small tubes are simply used to carry the germ or ovum up from the ovaries and empty into the uterus or womb.

The Uterus or Womb is a muscular sac situated in the pelvic cavity, bounded above by the rectum, below by the bladder, and on either side by the walls of the pelvic cavity. It is divided into what is known as a body and a neck. The body of the womb is very small, being only about four to six inches in length and a couple of inches in diameter when the animal is not pregnant. Near the front end, at the upper side there are openings by which the ovum enters. When the animal becomes pregnant, the body of the womb becomes enlarged and passes forward and to the left side of the abdominal cavity. It continues to enlarge as the time of pregnancy passes on, until the foetus, or young, has attained its full size. After the mare has had her young, the womb begins to get smaller until it attains its natural size again. The womb is very largely supplied with blood vessels and nerves. This is especially so when the ani-

mal is pregnant, as it takes a large amount of blood to nourish the foetus, or the young animal, before birth. It is made up of three coats. The inner is called mucous membrane, and in the mare, while pregnant, is covered with numerous processes about the size of peas to which the placenta or after-birth of the foal is attached. The muscular coat is next to that of the mucous coat, and lies between the outer and inner coats of the womb. It is made up of muscular fibres, and is strong and thick in the womb, much thicker than it is in the bowels or other organs, already mentioned. This coat supports and protects the foetus, or young, while being carried in the womb, and at the time of parturition, or what is commonly known as foaling, this coat also comes in use. It contracts the womb very forcibly on the foal, while the neck of the womb lies open, thus helping to force the foal out of the womb. This is important as the contraction of this coat produces what is known as labor pains. Lying outside, and covering around the womb, is a serous coat, a continuation of the serous coat of the bowels. The womb is held in place by strong ligaments attached to the sides, and from there to the hip bones. These are called broad ligaments. At the back part of the womb is the neck. It consists of an opening, formed by a projection about the size of an egg. This has a hard, gritty feeling when the animal is not in season. The neck at this time is closed. The neck of the womb is under control of the muscle around it, and this muscle is under control of the nerves of the womb. When a mare comes in season this muscle is relaxed to a certain extent, thus allowing the neck to open wide enough for the passage of a couple of fingers. By working around it with the fingers at this period it can be forced wide enough to admit a man's hand. If the mare is put to the horse at this time and becomes pregnant or with foal, the muscles in the neck of the womb contract, firmly closing it. It remains closed until the time of foaling. When, at the time of foaling, the labor pains come on, the muscle in the neck dilates, allowing the neck of the

womb to open large enough for the foal to pass out. The neck of the womb can be felt easily by oiling the hand and passing it into the passage of the womb. It will be noticed, too, that the neck spoken of projects into the passage.

The Vagina and the Vulva.—These two organs together make up the passage which leads into the womb from the outside. In the young mare they are separated by a thin curtain, or partition, made up of mucous membrane. This curtain is found about four inches from the outside, and is known as the hymen. It is destroyed, or should be, when the mare is first put to the horse, although it is broken down other ways, and in some cases it will disappear of its own accord. The part of the passage in front of the hymen is called the vagina. This passage, in structures, resembles the womb, but is not so strong. There are numerous glands situated along the inner lining which secretes a fluid to lubricate it. The principle use of this organ is to guide the penis during sexual intercourse, and at the time of foaling serves as a passage for the foal. That part of the passage behind the hymen is known as the vulva. It is about four inches long and about two or three inches high, varying according to the size of the mare. In front, it is separated from the vagina by the hymen membrane. It resembles the vagina in structure and is also provided with little glands in its inner membrane to secrete fluid to lubricate the passage. At the back part of the vulva or around the outside is what is known as the lips of the vulva, one on each side of the opening. The outside of the lips is covered by a very fine skin. Just below the skin, they consist of erectile tissue, which is the same kind of tissue as that of the penis of the horse. This tissue is found more abundantly in the lips of the vulva of the young mare than in those of an old mare. The opening between these lips is situated just below the anus, or the opening where the back bowel ends. At the back part of the vulva, on the under side, is an opening, or hole, about large enough for the passage of a

man's finger. Through this hole the tube leading from the bladder enters into the passage and allows the urine to pass into the vulva, through which it runs out of the body. The clitoris is situated on the upper side of this passage, just inside the lips. It can be seen in the mare when she works the vulva after passing urine. Just below the clitoris are found two or three small glands which secrete the fluid that passes away when the mare is horsing.

Mammary Glands, or what is known as the mare's udder or bag, are two in number, situated between the thighs. In the young mare they are very small, but after the mare is pregnant a few months these glands enlarge, until at foaling time they attain their largest size. They are covered outside by a thin, smooth skin. The substance of them consists of small glands and tubes retain or hold milk until it is drawn away from the bag either by milking or by the young animals sucking. During the time of suckling the young, the glands are largely supplied with blood, from which the milk is secreted. On the under side of each gland is found the teat, or that part taken hold of by the young when sucking. The end of the teat is pierced by several small holes, through which the milk passes.

GENITAL ORGANS OF THE BULL.

The testicles are ovoid in shape and well developed, its long axis being nearly vertical; the membrane which separate the two testicles is very strong.

The spermatic cord and artery are small compared with those of the horse.

The penis is long and pointed, and has an S-shaped curve in it just below the pelvic bones; this curve can be felt by feeling just behind the bag.

The sheath is long and runs further forward on the belly. It has a tuft of hair on the point of it. During the time the bull is serving the S-shaped part of the penis

is straightened out by the action of the protracters muscles, and drawn back into the S-shaped curve by retractor muscles.

The urethra is completely enveloped by the fibrous sheath.

GENITAL ORGANS OF THE COW.

The ovaries of the cow are comparatively smaller than those of the mare, but resemble them in structure.

The uterus or womb of the cow somewhat resembles that of the mare, but the inner membrane is different, being covered with sixty or eighty mushroom-like bodies about the size of a pigeon's egg, more flattened out. These bodies receive the name of cotyledons; to these the placenta or afterbirth is attached—a very important point with which every person interested should be familiar. These may be felt by examining a cow soon after calving. The passage from the womb of the cow is shorter than that of the mare, but is formed on the same principles.

The mammary glands constitute an organ termed the *udder,* which is composed of two symmetrical halves, placed one against the other. Each half is again divided into two distinct glands, each with its own teat, so that the udder consists of four mammae and four teats; behind this there may be two small rudimentary teats. In the center of each quarter, just at the base of the teat, is a large cavity, the general receptacle of all the milk ducts. From this cavity, which is sometimes large enough to contain a quart, proceeds down the center of the teat one defined canal from which the milk is drawn.

In the small ruminants as the sheep and goat there are two mammae and two teats, constructed like those of the cow.

CHAPTER V.

ANGIOLOGY.

Blood-Vascular System of the Horse.

Under this heading we describe the organs of circulation, by the action of which certain fluids are propelled through the body. It is customary to divide this branch of the subject into two sections, considering respectively the blood-vascular and lymphatic systems.

Blood-Vascular System.—This involves the consideration of the blood, a fluid which supplies nutriment to the tissues and receives effete material from them; the heart, a muscular organ which, by its contraction, initiates the motion of the blood; the arteries, a series of tubes which convey the blood from the heart to all parts of the body; the veins, tubes which return that fluid to the heart; and the capillaries, minute tubes joining the small arteries and veins.

Blood.—Blood is a fluid tissue, which nourishes all living structures, being the medium by which nutritive material is conveyed to, and effete or waste material conveyed away from the solid tissues. It is an opaque, thickish, clammy liquid, with a peculiar odor, sickly saline taste, and alkaline reaction. Its color varies in different parts of the same animal, that in the arteries being bright red or scarlet, while the blood in the veins is of a dark purplish hue.

When examined microscopically, the blood is found to consist of minute corpuscles, and a clear, transparent, yellow fluid, the liquor sanguinis, or plasma, in which the corpuscles float. The corpuscles are of two kinds, the red and the white or colorless; the former, by far more numerous, vary in proportion. Red corpuscles vary in shape, but in all mammals (animals that suckle their

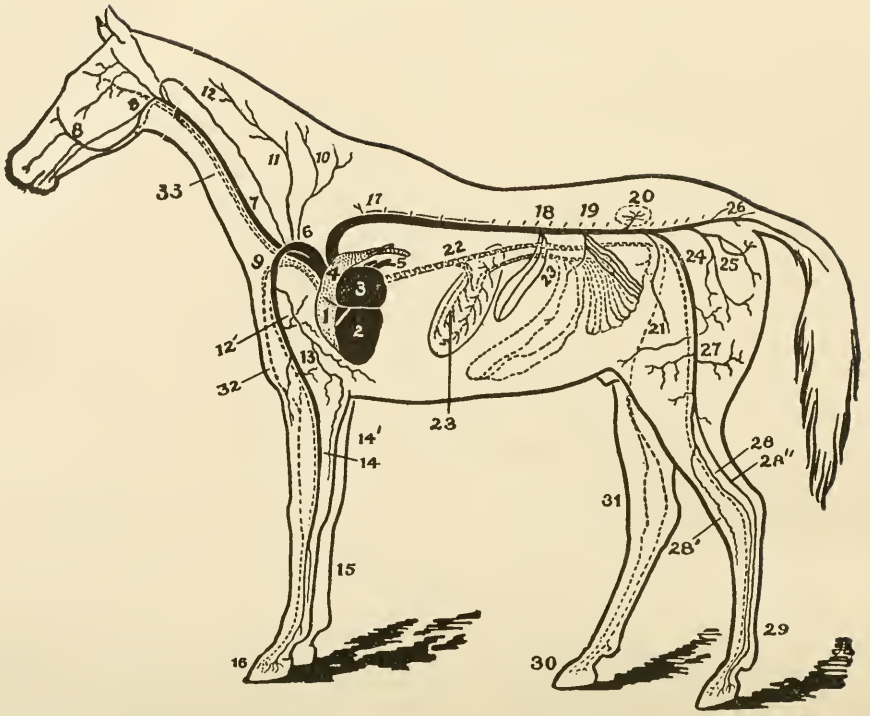
young) are more or less flat, the families excepted where they are oval, as in birds, reptiles, and fish, which are also nucleated. Their average diameter in the horse, ox or sheep is about 1-4000th part of an inch, their average thickness being about one-fourth of this. Each surface is depressed towards its center, hence the corpuscle is appropriately described as a bi-concaved disc.

The white corpuscles are larger than the red, round in shape, and nucleated.

The liquor sanguinis is pale and clear, and consists of water, fibrin, albumen, fatty compounds, extracts, odoriferous and saline matters. The serum is a thin, transparent liquid, of a pale-straw or yellow color, consisting of the liquor sanguinis deprived of fibrin. It contains nearly 90 per cent of water, is always slightly alkaline, and coagulates when heated, owing to the large quantity of albumen it contains. Fibrin is a white, stringy elastic substance, which, when the blood is in circulation, is in solution, and cannot be distinguished from the other constituents of the plasma.

Heart.—The heart is the principal organ of circulation; it weighs about six and one-half pounds in the average horse and acts as a force pump to force the blood through the arteries. It is composed of strong muscular tissue, which acts involuntarily, and is situated between the lungs, which are divided by what is known as the mediastinum. This is a division between the lungs made up of two folds, the heart being between them. The bottom or apex, of the heart is downward and rests just above the breast-bone; the upper part, or base is directed upward and to the left side, the left lung having a depression on its inner surface for the heart to work in. There is a covering or sack around the heart which helps to protect and support it in its place. It is attached above to the back-bone, and below to the bones of the breast. This sack is made up of fibrous tissue and is of a whitish appearance; inner surface is smooth, and supplied with numerous small glands which secrete an oily

PLATE V.



THE HEART AND THE CHIEF BLOOD VESSELS OF THE HORSE—AFTER MEGNIN.

EXPLANATION OF PLATE V

Blood-Vascular System of the Horse

1. Heart, right ventricle.
2. Heart, left ventricle.
3. Heart, left auricle.
4. Pulmonary artery.
5. Pulmonary veins.
6. Anterior aorta.
7. Carotid artery.
8. Glosso-facial artery.
9. Left brachial artery.
10. Dorsal artery.
11. Superior cervical artery.
12. Vertebral artery.
12′. Internal thoracic artery.
13. Humeral artery.
14. Radial artery.
14′. Cubital artery.
15. Great metacarpal artery.
16. Ungual branches.
17. Posterior aorta.
18. Coeliac axis.
19. Mesenteric arteries.
20. Renal artery (left).
21. Small testicular artery.
22. Posterior vena cava.
23. Portal vein.
23′. Hepatic circulation.
24. External iliac artery.
25. Internal iliac artery.
26. Lateral sacral artery.
27. Femoral artery.
28. Posterior tibial artery.
28′. Anterior tibial artery.
28″. Fermoro-popliteal artery.
29. Metatarsal vessels.
30. Venous plexus of the foot.
31. Internal saphenic vein.
32. Cephalic vein.
33. Jugular vein.

substance called serous fluid. This lubricates the outer surface of the heart and the inner surface of the sack so that in action it does not irritate the walls or surfaces. The cavity of the heart is divided into two parts, the right and left sides; each of these parts is again subdivided. The upper cavity is called auricle and the lower cavity ventricle; thus there are the right and left ventricle and right and left auricle. The right auricle communicates with the right ventricle by an opening in the septum or partition on the right side of the heart. This opening is guarded by a valve to keep the blood from flowing back into the auricle. The left auricle communicates with the left ventricle, same as on the right side. The right side of the heart is sometimes called the venous side and contains only venous or impure blood. The left side is sometimes called the arterial side. It contains pure blood only. This side of the heart is very much stronger and thicker than the right side.

Arteries—Arteries are tubes the purpose of which is to convey the blood from the heart. For this reason it is apparent that all arteries carry pure arterial blood with but one exception. The pulmonary artery carries the blood from the right ventricle to the lungs, and consequently carries impure or venous blood. Each time the left ventricle contracts it causes a wave, as it were, to pass all through the arteries. This contraction takes place when in a healthy condition about 36 to 42 times every minute and gives rise to what is known as the pulse. This wave, or beating, may be detected at any point where the artery is situated so closely to the surface as to affect the outside of the body sufficient to be felt by placing the finger on the point; consequently the pulse may be counted at any of these points. Place your forefinger on the lower edge of your own lower jaw directly under the corner of your mouth. At this point an artery passes out over the jaw bone and therefore runs very close to the surface, making it quite possible to feel the wave caused by the contraction of your own heart, quite dis-

tinctly. Near this point on the jaw of the horse the pulse is most conveniently felt and counted.

The walls of the arteries are composed of elastic tissue and after death are always lying open. Blood is never found in them after death because they continue to contract sufficiently long enough to force all the blood through them.

Veins.—Veins are tubes in construction not so strong as the arteries—the purpose of which is to convey the blood from all parts of the body to the heart. The heart wave does not affect the veins, and consequently the pulse cannot be detected by placing the finger on an exposed portion of one of them. It is also apparent that all veins carry impure or venous blood with but one exception, viz., the pulmonary vein, the purpose of which is to conduct the purified blood from the lungs to the heart.

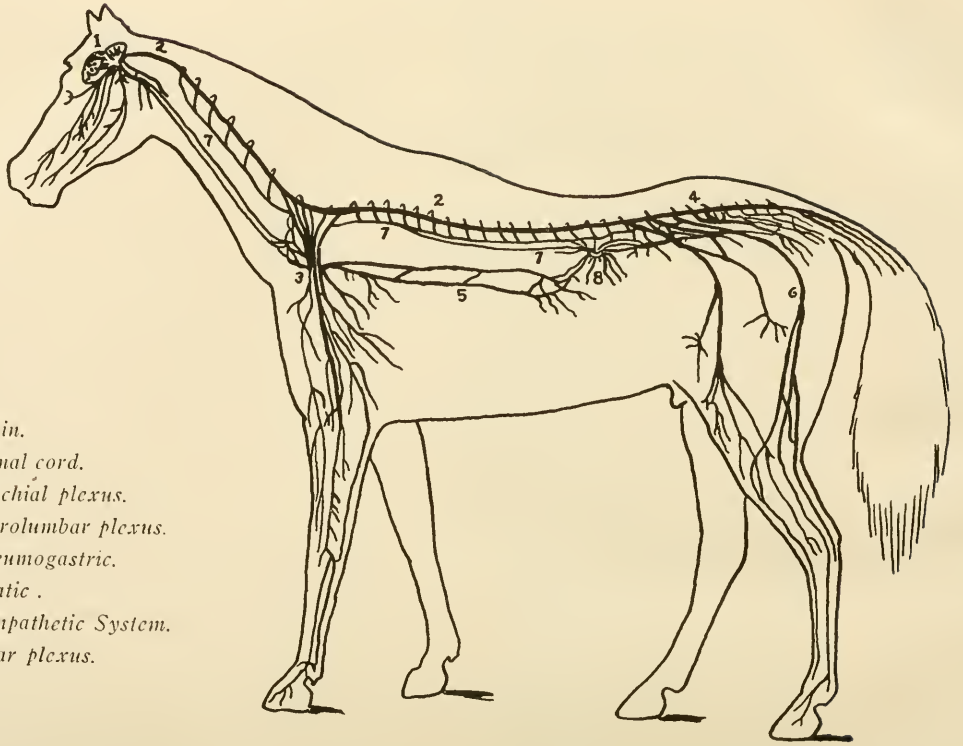
Capillaries.—The small arteries terminate in a system of minute vessels—the capillaries—which are interposed between the termination of the arteries and the commencement of the veins, forming plexuses (network) which vary much in arrangement. Their average diameter is about 2/1000ths of an inch, varying in different construction of the organs, smallest in the brain and mucous membrane of the intestines, larger in the skin, in glands, and the interior of bones. All arteries do not terminate in capillaries, an exception being in erectile tissue of the penis, where arteries end in cells or cavities placed at the origin of the veins. As the blood passes slowly through these capillaries, the nourishment is absorbed from it through their very thin walls to supply the tissues of the body. When the blood passes through this capillary network it again enters into large vessels called the veins, which carry it on its way back to the heart.

Course of the Blood.—We have seen that the heart is divided into a right or venous, and a left or arterial portion. The blood is pumped by the heart to all parts of the body, through the arteries, passing through

the capillary system, where it parts with its nourishment, is collected and returned to the heart by the veins, is again pumped by the heart to the lungs, where it is purified and returned to the heart to again commence the circuit as before.

Lymphatic System.—The lymphatic or absorbent system is closely connected with the blood-vascular system, and is made up of very fine minute tubes and glands. These convey from the tissues of the body a clear fluid known as lymph, and pours it into the blood of the veins as it is on its way back to the heart. These glands are found all through the body; for instance, there is a large group inside the thigh or stifle joint of the horse, and another large group inside the shoulder. It is important to note these, as they sometimes become inflamed and the leg is swollen. They are then the seat of the disease called weed in the leg, or lymphangitis.

PLATE VI.



1. *Brain.*
2. *Spinal cord.*
3. *Brachial plexus.*
4. *Sacrolumbar plexus.*
5. *Pneumogastric.*
6. *Sciatic .*
7. *Sympathetic System.*
8. *Solar plexus.*

NERVOUS SYSTEM OF A HORSE—AFTER MEGNIN.

CHAPTER VI.

NEUROLOGY.

This illustration shows where the brain, spinal canal and the principal nerves of the horse are located.

Study of the Nerves.—The nervous system is a very important set of organs controlling the motion of the various members of the body and supplying the different senses of feeling, seeing, hearing, smelling and tasting. The two principal organs of the nervous system are the brain and spinal cord.

The brain is the center of the whole nervous system, and is situated in the cranial cavity, surrounded by three delicate membranes, the outer one being attached to the inner wall of the bones forming the brain cavity. The brain contains several important nerves called cranial nerves, which are given off from the brain and pass down through the various foramen or openings in the head to supply the different organs situated there. The optic nerve passes down to the eye, giving the sense of sight. The auditory nerve passes down to the drum of the ear to give the sense of hearing. The olfactory nerves, which give the sense of smell, are situated in the mucous membrane lining the nose. The nerves passing down to the tongue give the sense of taste. Other nerves pass down to the lips, teeth, mouth and face, giving motion and feeling to the parts mentioned. Others pass down to the pharynx or gullet, giving it the power of swallowing.

The spinal cord passes from the brain through the openings in the bones of the back, which gives off numerous small nerves that supply the muscles of the back with motion and feeling. Nearly opposite the shoulder blade the spinal cord gives off a large trunk of nerves, portion of which supplies the heart and lungs with nerv-

ous power. This is a point of importance, for if the spinal cord becomes injured in front of these nerves immediate death is the result. The other portions of this trunk of nerves supply the shoulder, chest and muscles of the front legs. Passing backward along the spinal cord is found the sympathetic system of nerves, which go to supply the bowels, stomach, liver, kidneys, and other organs situated in the abdominal cavity. Coming backwards along the spinal cord to about oposite the hip bones, is another set of nerves, one of which goes to supply the rectum, or back bowels. Others go to the generative and urinary organs where they assist in performing their functions. Other nerves pass to the small organs situated in the pelvic cavity; some of these nerves pass down to the hind legs, supplying them with nervous power. The remainder of the nerves go to supply the tail.

The difference between the nervous system of a horse and other animals is not worth mentioning.

CHAPTER VII.

AESTHESIOLOGY.

The study of organs of special sense, the ear, eye and organs of special sensation, skin, hair, foot, etc.

THE EAR.

The apparatus of hearing is composed of three parts the outer, middle, and inner ear; the two first being accessory for the collection and transmission of sounds, and the latter the essential organ which receives the impressions thus conveyed.

The inner part, or drum, of the ear, is situated in the hardest bone of the body, called the petrosal. The nerve which passes into the drum of the ear and gives the sense of hearing, is called the auditory nerve. From the drum a small opening passes out into the outer part of the ear; this is the portion which is seen on top of the head. It is made up of a membrane known as the cartilage, which gives the ear its stiffness. This cartilage is covered by a fine, delicate skin, covered on the outside by fine, short hair. Situated on the inner side of the outer ear are numerous long hairs projecting outward, the use of which is to keep foreign bodies from dropping into the ear. The ear is moved backward and forward by small muscles which are attached around it.

THE EYE.

The apparatus of vision comprises the essential organ, the globe of the eye or eyeball, and its accessory parts or appendages. The eyeball is situated in the orbital fossa, mentioned in chapter on the bones of the head. It is chiefly made up of several coats around

the outside, and in the center by the humours of the eye. On the inner side of these coats is a thin membrane called the retina, which contains the branches of the optic nerve. This receives the reflections of objects as they pass through the humours of the eye and from which the sensation passes along the optic nerve to the brain. The oblong opening seen in the middle of the eye is known as the pupil. If a horse be led from a dark stall into the light and the pupils of the eyes watched closely, it will be noticed that they get smaller, but on returning it to the stall the pupils will be noticed to dilate or get larger; thus it is seen that the pupils do not always remain the same size. The chief use of the pupil is to gauge the sight. At the back part of the eye are several muscles attached from around the eye to the bones in the fossa. These muscles move the eye and assist in holding it to its place. Around the front part are two movable curtains, one above and the other below, called eyelids, the use of which is to open and close the eye, and also to protect it from injuries. Around the free border of the eyelids are what is known as the eyelashes, which keep foreign substances from falling into the eye. Situated in the inner angle is what is known as the haw of the eye; this membrane also helps to protect it. In the corner of this angle is a small duct or opening, through which a fluid called the tears passes down into the nasal tubes, from whence it is carried down through the bones of the head and emptied into the under part of the nostril or nose. A small gland is situated on the upper part of the eye. This gland secretes the tears which lubricates the eyes. The color of the eye is generally brown, but in some cases it is white. It is then called a moon eye.

THE SKIN.

The skin is a membrane or external casing of the body. The skin itself consists of two layers covered with hair, fine or coarse, long or short, according to its position or purpose which nature intended it to serve.

The outer layer is called the epidermis, the inner the dermis.

The Epidermis.—The epidermis is the outer layer. It is not supplied with nerves and blood vessels, its purpose being to protect the inner layer. This layer undergoes a continual process of being made up and passing away in dandruff.

The Dermis.—The dermis or true skin lies under the epidermis. It is well supplied with nerves and blood vessels, part of the nerves being the nerves of touch. This fact accounts for its becoming so very sensitive and painful when through injury of any kind the outer layer is scraped off. It is attached to the body by a layer of white tissue known as the areolor tissue, this being that which is cut through when the animal is being skinned. The thickness of the skin varies in different parts of the body, being thinnest in the under parts. The sweat glands are situated in the dermis.

THE HAIR.

There are three kinds of hair on the horse—the common, the finest of the three, covers most of the body; that of the mane and tail, coarse and long; and that growing on the muzzle or nose and lips, long and usually black, known as tactile or cat hairs.

On the inside of the front legs, just above the knee, and on the inside of the hind legs, above the hock, are rough, horny spots. These are called chestnuts.

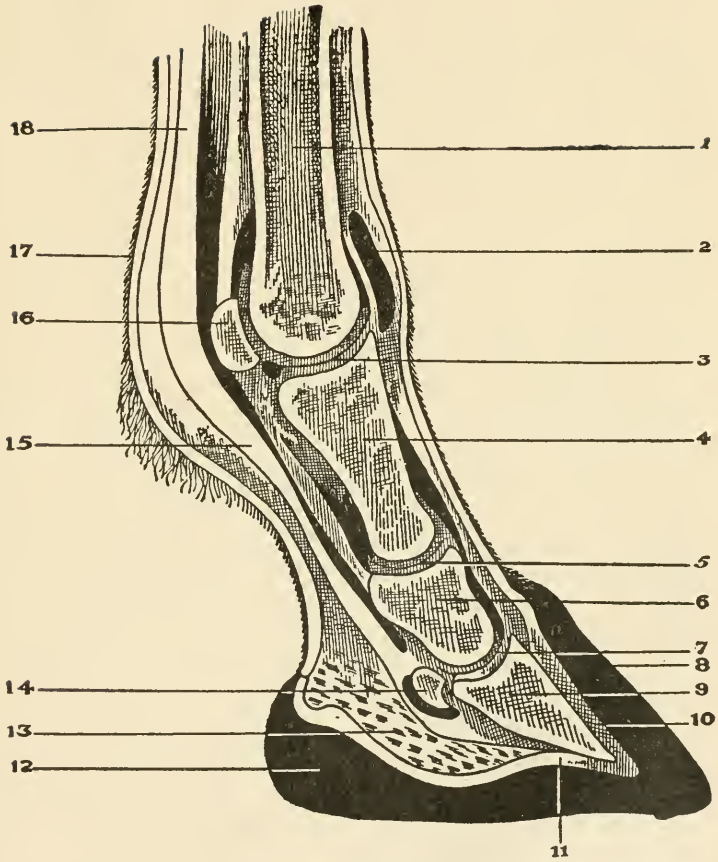
EXPLANATION OF PLATE VII

Anatomy of the Foot.—This illustration represents the foot of a horse sawed from above the fetlock down through the center of the foot. It shows the structure of the foot, the name of each part being given according to number.

1. Lower end of large metacarpal, or cannon bone.
2. Bursa, which secretes the joint oil that lubricates the place where the tendon, or cord, on the front of the leg passes down over the front of the fetlock joint. This is important as it sometimes gets injured and becomes enlarged. It is then called a bursal enlargement, and is of the same nature as a wind gall.
3. Fetlock joint.
4. Os suffraginis, or large pastern bone.
5. Pastern joint. This joint is important; when diseased it is the seat of a high ringbone.
6. Os coronae or small pastern bone
7. Coffin joint. This joint is important, for when it is diseased it is known as a low ringbone.
8. Wall of the hoof.
9. Os pedis, or coffin bone.
10. Sensitive wall, or quick of the foot.
11. Sensitive sole, or quick of the foot.
12. Frog of the foot, or horney frog.
13. Planter cusion, or fatty frog.
14. Navicular bone. This is also important, for when diseased it is the seat of navicular, or coffin joint lameness.
15. Back tendons below the fetlock.
16. Sesamoid, or feltock bones.
17. Skin.
18. Back tendons above the fetlock.

Foot.—In equine anatomy the word "foot" implies the hoof, together with the bones and soft structures con-

PLATE VII.



CROSS SECTION OF THE FOOT OF THE HORSE.

tained therein. Many of these objects have already been described, so that our description here will be confined almost to the hoof and the structures with which it comes into immediate contact internally.

Wall of the Foot.—The wall is that part of the hoof seen when the foot is resting flat on the ground. It is divided into the toe, the quarters, the heels and the bars. The toe forms the front, and is the thickest and strongest part of the wall. The quarters are situated at the side. The walls are not nearly so thick here as at the toe, but are almost straight up and down. The heels are situated at the back part of the foot. From the heel is a process of hoof, which looks like a bar, passing forward between the frog and the sole of the foot; this can be seen plainly by raising up the foot. There is one of these at each side of the frog. They act as braces to the heel and the quarters of the wall; these are called the bars. Covering the outside of the wall is a fine membrane called the periople, which gives the hoof its polished appearance. This can be seen best when the hoof is well washed off, as it is after traveling through wet grass. This membrane keeps the moisture in the hoof and protects it from water. This is a point of importance in shoeing horses, as it is very injurious to file the wall too much. Around the top part of the wall, where it unites with the skin, is a groove which contains a white band, called the coronary substance, or band. This nourishes the wall of the hoof, or, in other words, it is from this that the wall of the hoof grows. The under part of the wall, or that which rests on the ground in the unshod animal, is called the spread of the foot. On the inside of the wall, attaching it to the bone of the foot called the os pedis, is the part called the quick, or sensitive laminae. It is important to note this when driving nails in shoeing. The nail should not be driven into this membrane, nor should it be even pressed upon, for it is very sensitive. When a nail has been driven so as to injure the membrane it is a common expression to say, "You have pricked that horse's foot."

Sole of the Foot.—The sole is a thick plate of horn which helps to form the under part of the hoof. It is situated between the inner border of the under part of the wall already mentioned and the front of the frog. The under part of the sole is concave, or hollowed out. The upper part of the sole is attached to the under surface of the os pedis bone, or bone of the foot, by a membrane called the quick, or sensitive sole—this membrane is merely a continuation of the sensitive laminae. The outer part of the sole is attached to the inner part of the wall. When pared down a white ring is seen where the sole and the wall unite. At the back part of the sole there is a notch the shape of the letter V; in this notch the frog is situated. It is important to remember when shoeing never to let the shoe rest on any part of the sole; neither is it well to pare off too much of the barky-looking substance of the sole, as this helps to keep the moisture in the foot. When this is taken off it allows the moisture to escape and the hoof becomes dry and contracted.

Frog of the Foot.—The frog is the important spongy horn found in the V-shaped notch in the back of the sole. It is wide at the back and helps to form the heel of the foot; the pointed part in front is called the apex of the frog. The under part of the frog is triangular in shape and has a hollow in it called the cleft of the frog. There is a hollow at each side of the frog, between it and the bars, called the commissures of the frog. On the upper part is a membrane, known as the sensitive frog, which attaches it to the under part of the os pedis, or foot bone. This membrane is simply a continuation of the sensitive sole spoken of in connection with the sole. The back part of the frog is the widest part and spreads out to form the heel.

The study of the foot of the horse is of the greatest practical importance, owing to the many diseases and injuries to which it is liable. It resolves itself here into the consideration of the hoof or horny case, and the parts contained within it.

CHAPTER VIII.

EMBRYOLOGY.

THE DEVELOPMENT OF THE YOUNG.—We must here first speak of the ovum or germ, which is secreted by the ovary of the mare. Every time she comes in season (which occurs every three weeks during the hot weather) this ovum passes down the tubes before the womb as before mentioned, where it remains a few days and then dies if she is not put to the horse; but if, during the time this ovum is in the womb she is put to the horse and one of the spermatozoa from the semen of the horse comes in contact with it (the ovum) and a union of these takes place, then the rest of the semen dies and passes away, and the neck of the womb contracts gradually until it is perfectly tight. These two little bodies begin to grow when united and form the foetus, or foal. The foetus may be for convenience divided into three parts, viz.: the foetus proper, the navel string, and the placenta. The placenta is the part which is found covering the foal and is attached to the little pea-like elevations on the inside of the womb. This covering is found to be full of small blood vessels which finally unite to form two larger vessels, known as the navel veins. These carry the blood up through the navel opening of the foal and then to its heart. By the action of the heart it is forced all through the body of the foal and returned again to the heart. It is then forced down another artery to the navel opening, along the navel cord, into the placenta again, where it is distributed through the small blood vessels. When the blood comes down this cord from the foal it is in its impure state, and while it is passing through these small vessels in the placenta it comes very close to the small blood vessels in the womb. The blood is cleansed and nourished from the blood of its

mother by a process similar to that which was spoken of when discribing the lungs. The foetus, or foal, does not grow so fast the first month as it does later on. At the age of seventeen weeks the first hair appears on the lips and the tip of the tail. Between the thirty-fifth and the fortieth week the foal begins to show signs of life, and is completely covered with hair. After this time it grows very rapidly and may be seen moving around by watching the flank closely. The mare carries her foal eleven months, but in some cases an aged mare has been known to carry her foal over twelve months. In rare cases young mares may lack a few days of eleven months.

The Average Periods of Gestation of Domestic Animals.

Mare	11 months	Goat	5 months
Ass	12 months	Sow	3½ months
Cow	9 months	Bitch	9 weeks
Sheep	5 months	Cat	8 weeks

Note—A mare having been served by a stallion may occasionally in the course of four or five weeks, manifest a desire for a second visit from the male; is again served and conceives both times. This is known as superfoetation. Such a case has been recorded by a veterinarian; the animal in question, a mare, giving birth to a horse colt and a mule colt, both dead. The mare had been covered by a jack and subsequently by a horse.

Signs of Pregnancy.—The veterinarian is occasionally called upon to give an opinion as to the pregnancy or non-pregnancy, of an animal and consequently should familiarize himself with the various indications which tend to prove the absence, or presence, of this condition. As a rule, when the mare conceives, heat, or the desire for the male, is no longer observable, and, on being led to the horse, she not only refuses to receive his caresses, but assumes the offensive, viciously striking and biting at him until led away. Soon the hair becomes more

glossy, and the mare becomes quieter in disposition. This change is usually well marked in mares that are of a vicious disposition. The abdomen gradually enlarges as pregnancy advances, the right side being a little larger than the left. This enlargement is especially well marked in the cow. In some cases the beating of the foetal heart may be heard with the assistance of the stethoscope. Such an examination is, however, very likely to give rise to mistakes. After the eighth month well-marked symptoms of pregnancy are manifested, the belly at this time being considerably distended, the back sinking, etc. Before this time it is, however, impossible to make a positive statement as to the condition of the animal except by making a very close and thorough examination per rectum. The rectum should be cleared out by means of an enema (injection) of tepid water; the hand and arm should be well oiled and passed into the rectum. The region of the uterus being reached, an examination may be made of its condition. As the time for parturition approaches, the ligaments relax to a greater or less degree, and a well-marked depression or sinking in the lumlosacral region may be observed, the udder or bag enlarges, and milk is secreted. The secretion of milk sometimes appears long before the time of parturition, and has frequently been noticed to take place in animals that have never been bred. As a rule the animal shows slight uneasiness for a day or two before parturition, slight abdominal pain, etc., being manifested. About this time the vulva becomes larger, and presents more or less tumefaction. There may also be observed a flow of mucous taking place from the vulva for a day or two before parturition.

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